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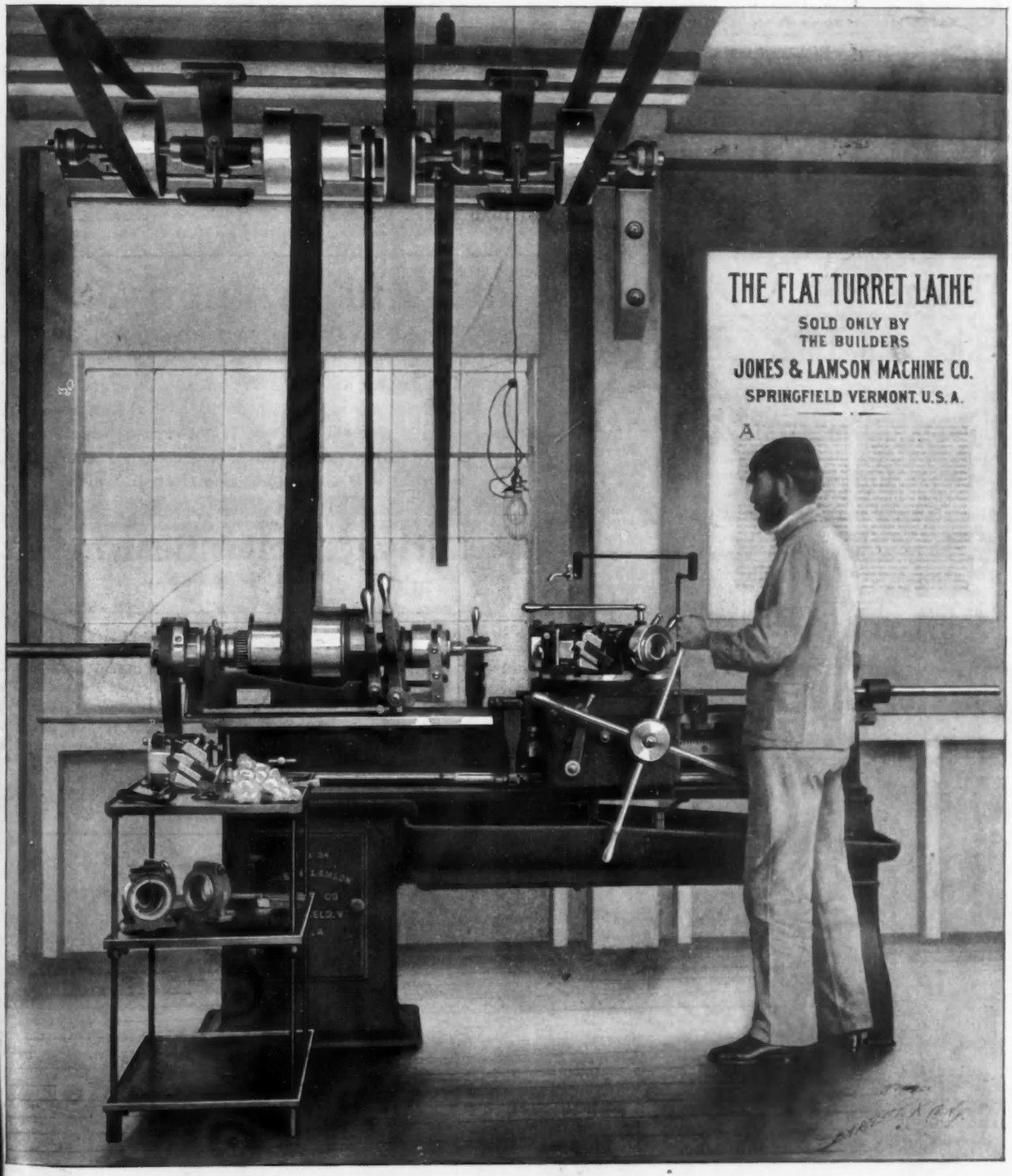

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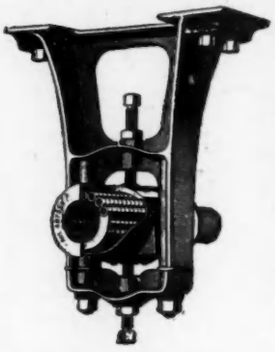

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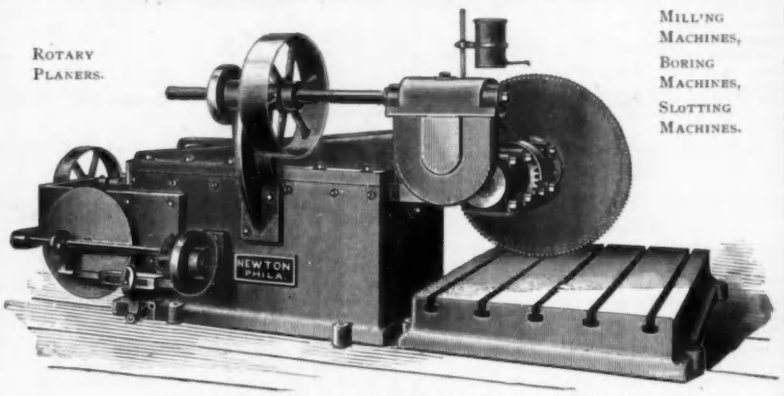

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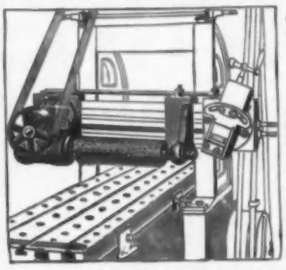

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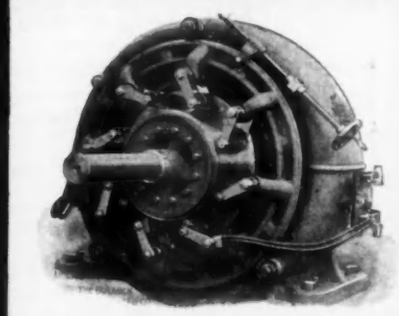

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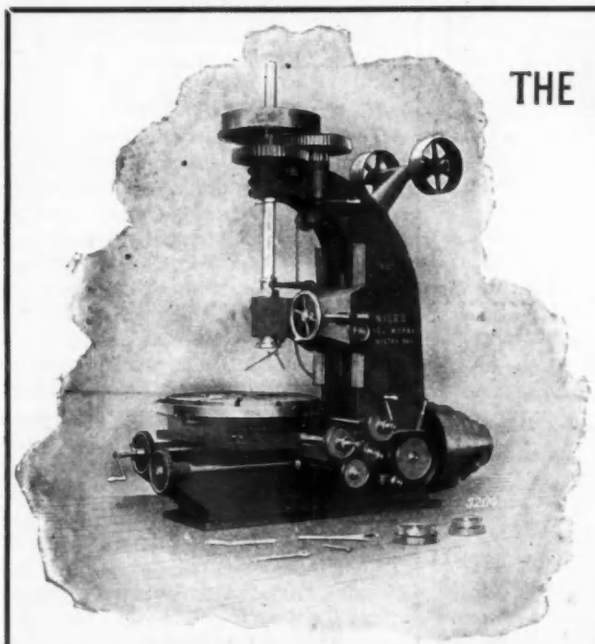

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The College Shop.

Professor Hood's article in another column, explaining a method of adding to the usefulness of the college machine shop, prompts us to refer to a method for introducing commercial work in such shops which, while it has already been urged by us, will bear repetition, especially as our advocacy of it has, so far as we know, led to no results.

We would be the last to deny the value of the exercise system in the college shop, and, indeed, for new students without previous shop experience, the system seems to be about the only alternative—a sort of Hobson's choice. It is, however, much more than this. We never see the results accomplished by it without a new feeling of astonishment at these results, which are, in many cases, little short of marvelous. No one will claim, however, that it is all that is to be desired, or that for students who have made some advancement or for those who have had some previous shop experience, work of a commercial character is not desirable. Many have, it is true, concluded that such commercial work is impracticable, but no one, we believe, has said that it is not desirable; and this not alone from the educational standpoint. The few students who still come from the shops are usually and naturally poor, and the spectacle of well equipped shops where they might earn substantial amounts standing idle during vacation time is anything but gratifying. There can be no doubt that a plan which would utilize these shops in a manner which would enable students to earn money in them would add largely to the number of students from the shops—a thing which we have insisted upon over and over again and which we believe offers the greatest existing field for added usefulness which lies within the reach of the engineering schools.

That the manufacture in these shops of machines for sale in the open market is impracticable we are prepared to admit, but what is to prevent such a shop from making contracts with manufacturers to supply them with parts of their machines? Why not make for such manufacturers parts of steam engines, pumps, or rock drills? In the present congested condition of machine shops all over the country, there is no doubt whatever that many manufacturers would jump at the chance to thus increase their output. With such a contract in hand the natural procedure would be to first scheme a method of manufacture, then to make drawings of the necessary special tools and fixtures, then to make the fixtures, and finally to make the articles themselves—a procedure which would offer a series of class room, drawing room, and shop exercises in manufacturing methods which are now scarcely touched upon in the school work, but which all will admit to be of the first order of importance. When finally the parts are made they are to be paid for, and this pay would go directly to the student doing the work, with a small percentage of reduction to cover the cost of power, supplies, and other incidentals. For it is to be remembered that in making its prices the college shop, unlike commercial shops, has no administration, installation or other items of expense to include, since these are already provided for, and are not contingent upon the operation of the shop as a productive enterprise. It would follow from this on the one hand that the shop could make prices that the manufacturer could not afford to ignore, and, on the other, that the students could be well paid for their work—perhaps better than its real value would justify, and to this, in view of the use to be made of the money, few would object.

Meanwhile, can any one doubt the influence that such work would have on the students coming from the high schools? Is it not plain that it would quicken the interest of every one connected with the shop, and change it from a mere practice laboratory to a place alive with interest to all?

In selecting the parts to be made the educational value of the processes involved would, of course, be a leading consideration. At the start individual parts only would probably be made, but there is no reason why the same plan is not applicable to more ambitious efforts. For instance, is there anything to prevent contracting with a Corliss engine shop to supply it with governors? A great variety of such compound parts, as they may be called, could be named, which would be well adapted to production on this plan, and which would naturally supply more of the interest due to "making something" than would single pieces having no operative connection.

We can see no reason why the plan suggested is not feasible, practicable, and eminently desirable.

The Wages Question Again.

The article by Mr. John Richards which appears in another column should set our readers to thinking. Few men, it should be remembered, have had better opportunities for making observations on this subject, and few are better qualified to draw definite conclusions from what they have seen, while no one else, perhaps, combines both these qualifications in the same degree.

Our readers will naturally expect some discussion by us of the relationship between the premium plan and the one described by Mr. Richards. Our knowledge of the plan described by him is limited to what he has said about it, and we may be led to erroneous conclusions from this fact, but the matter appears to us as follows:

The premium plan was devised primarily for repetition work, in which the cost of each operation on each piece could be made the basis of an offer to the individual workman, whereby the results of increase of output through his efforts should

be divided between him and the works, thus at the same time increasing wages and reducing costs. A slight modification which was suggested in the first publication of the system, but which, so far as we know, has not yet been tried, applies to machines which, while a regular product, are yet not made in sufficient quantities to justify the extreme differentiation of costs necessary to its application to individual operations. In this modification the time required to construct the machine as a whole is taken as a base, and the premium is offered to the men in a body for the reduction of this gross time limit, and in this form the premium plan will be seen to approach more nearly to the one described by Mr. Richards.

Still another modification is similar to the last, except that it is applied to new work, and is based on the estimated cost, and this modification is, we are informed, in use in one large general engineering works. In this form the plan approaches most nearly to the English system, the leading difference in effect being that under the English plan the workmen receive all of the saving, from the wage cost standpoint, while under the premium plan they receive but part of it. While this is true on its face, it is clear that under the English system of production the employer gets his share in the end. Remembering that the system of specialization and duplicate manufacturing is less followed there than here, individual estimating and building being the rule, it is plain that new data are constantly accumulating which have been taken from work done under the stimulus offered by the co-operative system, and that the use of these data in future work tends to steadily reduce the estimates for that work. It is thus plain that under English methods of production the system leads to a progressive reduction of cost, but we fail to see how it would lead to this result if applied to our own methods of manufacture, except through cuts which would be analogous to, and as objectionable as, cutting piece prices in piece work shops. This progressive reduction of cost under duplicate manufacturing methods is the characteristic feature of the premium plan, and this plan, it seems to us, is thus better adapted to American methods, although the co-operative plan seems to be well adapted to English methods. The two plans have been developed under different conditions, and it is to be expected that each will be best adapted to the conditions under which it was developed and to which it was intended to apply.

This comparison may be carried still further. Thus it will be observed that the English plan savors strongly of that orderly, dignified, and systematic procedure under which business of all kinds in England is done, and as a part of that procedure we have no doubt that it works well. We doubt, however, if this would be the case under the "catch as catch can" methods of doing business to which, for better or worse, we in this country are committed. Prices here for goods not standard are often made by salesmen without consulting the office, or by the office on the "precedent and the rule of three" method, in which there is very little of "taking out the quantities" or systematic estimating of any kind, and an establishment which insisted on the orderly procedure described by Mr. Richards would probably find that some one else had taken the order (and perhaps filled it) before it had its estimate ready.

In the last analysis the two plans are based upon the same fundamental idea, that of making the interests of employer and employee identical, and looked at from this standpoint the fact that the co-operative plan has worked so long and so well as Mr. Richards testifies is a demonstration that this most desirable end can be attained, and that when attained it results in harmonious relations between the parties and increased prosperity to both. In this indirect way, then, the satisfactory working of the co-operative plan may be regarded as valuable testimony in favor of any plan which really accomplishes this unification of interests.

It is clear, however, from what Mr. Richards says, and from other evidence as well, that the admirably cordial relations existing between the proprietor of the Tangye shop and the men working in it are not due entirely to the mere system of paying or of dividing the money earned by increased effort and output. The picture drawn is that of a man fully recognizing the human element in industrial operations; willing to concede that others can help him in the conduct of his business, and appreciative of their help. Other things equal, such men can always get more out of workmen than others can.

The Niles-Bement Pond Co.

The much discussed amalgamation of the Niles Tool Works, Bement, Miles & Co., Pond Machine Tool Company and the Philadelphia Engineering Works has been accomplished at last, and it undoubtedly forms the largest and most important machine-tool building interest in the world. That its influence, good or bad, upon the machine-tool business generally, and especially that part of it that has to do with heavy tools, will be far-reaching and profound, there can be no doubt. Whether its effect may be good or bad, however, will obviously depend upon the course pursued by the company. Its affairs are in the hands of very competent men—men who have abundantly demonstrated their ability to see beneath the mere surface of things and to successfully cope with difficult commercial and engineering problems. It is to be supposed that they realize the peculiar difficulties they will have to confront, as well as the advantages of the organization; and in fact we know that they do realize that they can succeed only by careful and thoroughly business-like procedure; that their position is radically different from that of the Standard Oil Company, for instance, and tnat to attempt to play the part of a monopolist will be to simply invite and stimulate new competition.

It is the intention to run the separate establishments just as they have been running, and they will be in charge of practically the same men, both commercial and mechanical. The Philadelphia Engineering Works will, however, give up the manufacture of engines and all else, in fact, except overhead traveling electric cranes. The other shops will continue to build the tools they are now building and to market them through the same channels, both here and abroad. The company, will, however, be at liberty to make such changes as may seem advisable in the future, for it will have the absolute control of the various plants which results from actual ownership.

In that respect this organization differs radically from a trust, and so far as the ethics of the matter go, we fail to see how anyone has ground for complaint. Men who have the necessary amount of money may buy what they like that is for sale, and the same right to buy a machine shop already built and running as they have to build a new one out of the raw materials. In this case the public ought to find its protection in the fact that whenever prices of machine tools go inordinately high, new capital and new brains will be drawn into the business; for the raw materials of machine tools are as readily obtainable by one man or shop as by another.

That the new company intends to run its business upon business principles is best shown, perhaps, by the methods pursued in its organization. There was no booming, no under-writing and no floating of stock upon the market. The stock was all subscribed for privately, and most of it by men who had been connected with the various component establishments —a procedure vitally different from what we observe in the ordinary "promoter's" scheme, and meaning, we think, that the men who are best acquainted with the business and know what can be accomplished by various economies of administration feel confident of the success of the undertaking conducted upon strictly legitimate business principles.

The general offices of the new company will be at 136-138 Liberty street, New York, and there Mr. Robert C. McKinney, the president of the new company, will spend most of his time, instead of in Hamilton, as heretofore.

The capital stock of the company is $8,000,000, which is divided into $3,000,000 6 per cent., cumulative, preferred stock and $5,000,000 common stock. All the

common and all but $1,000,000 of the preferred have been issued, the latter being retained in the treasury for the purpose of acquiring minor interests in the Niles Tool Works Company.

The following are the directors that were elected at a meeting held on the 15th inst.: Alexander Gordon, president of the Niles Tool Works Company; Charles A. Moore; Clarence S. Bement and Frederick B. Miles, of Bement, Miles & Co.; Gordon Shillito, Thomas T. Gaff and Daniel H. Holmes, of Cincinnati; Frederick W. Gordon, of Philadelphia; George T. Reiss and James K. Cullen, of the Niles Tool Works Company; E. C. Burke, of Cleveland, Ohio; Walter L. Clark, of the Niles Tool Works Company; A. C. Stebbins, of the Pond Machine Tool Company; W. S. McKinney, of Pittsburgh, and Robert C. McKinney.

The officers are as follows: President, R. C. McKinney; first vice-president James P. Cullen; second vice-president, A. C. Stebbins; third vice-president, Walter L. Clarke; treasurer, Charles L. Cornell; secretary, E. M. C. Davis.

The engineers of the company will be Frederick B. Miles, of Philadelphia, and Geo. T. Reiss, of Hamilton.

Commercial Review.

NEW YORK, FRIDAY EVENING,
August 18, 1899.

MACHINISTS' SUPPLIES.

Reports of a volume of trade comparatively lighter than at previous times of the year are quite common in the machinists' supply trade with consumers, but business is far more active now than generally at this time of the year. Prices in general are tending upward, and consumers recognize this fact so keenly that they do little haggling over figures. Otherwise they would stand a good chance of getting left. "We are now making prices subject to change at any time without notice," remarks the spokesman for a local machinery and supply house which does an extensive business. "An advance is liable to occur at any time. Recently we made a price on three tons of bolts, having previously gotten quotations from the factory, and in 48 hours the price went up 10 per cent."

"We should now be having a heavy business if we could only get the goods,' says the manager of a twist drill and small tool house. "We are doing well as it is. July was our second best month this year. There has been no advance in the price of drills since the 5-per-cent. raise, made June 26. The export price has not been advanced even to cover the 10-per-cent. increase in domestic price which took place last November. There seems to be no great danger that drills sold ostensibly for foreign trade will be put upon the home market, since the export houses which buy drills for the most part are a few prominent ones which would not think it worth their while to play an underhanded game. The less responsible export houses do not seem to have many orders for twist drills.

"In view of the radical advances in general hardware that have been taking place," observed our interlocutor, "retail dealers have taken heavy stocks, and I do not think that they are having quite the success in unloading these that was expected. In the not altogether improbable event that prices react, they will be badly off. The advances that have been made on twist drills, however, were sprung on the public so suddenly that there was little or no time to anticipate them by placing orders.

"Heavy stocks of twist drills," he said, in answer to a question, "are not usually carried in the East. Here in New York there are large manufacturers' stocks, and since dealers are so close to a market to draw upon, they do not consider it profitable to carry a large valuation on their own shelves. There is one firm in town whose purchases from us amount to some $15,000 a year, and yet they carry only about $1,000 worth of drills in stock. They fill their mail orders by drawing directly upon us, which they are doing daily. In Buffalo and points West jobbers carry larger stocks of their own. One, for instance, claims to keep on hand $6,000 of one make of drills and $4,000 of another. In Chicago the drill manufacturers do not commonly keep as heavy stocks as they do here. The speculation in twist drills seems to have been chiefly in the West."

Montgomery & Co., a well-known machinists' supply selling firm, of New York, have extended their quarters into an adjoining building, where they are fitting up a second-floor room, 45 by 125 feet for offices and show rooms. They will carry a complete sample stock of several lines of small machines and tools including those of W. F. & John Barnes, both for metal and wood working; the Seneca Falls Manufacturing Company, W. C. Young Manufacturing Company, etc. Full lines of forges and grinding machines will be exhibited. It is said that to carry complete lines of several makes of small machines is somewhat an innovation in this city.

MISCELLANEOUS.

It is reported from Philadelphia that the Cramps are laying off many hands because of the difficulty in getting iron and steel to carry on the work. Five hundred men were suspended a few days ago, another 500 August 15, and it was expected that 500 more would be by the close of this week. The company is said to have $20,000,000 worth of work on hand. Out of thirty-seven vessels under construction at shipyards on the Delaware river, fully twenty-one will be delayed by scarcity of material.

The New York Shipbuilding Company, Camden, N. J., is in the market for a considerable quantity of machinery and supplies. The value of twist drills and other "small stuff" called for is said to be $4,000 or $5,000.

A. & F. Brown have received an order for about $20,000 worth of power-transmitting machinery from the McCormick Harvesting Machine Company, Chicago. Among this will be a rope drive which will involve the use of shafts 10 and 12 inches in diameter, and the largest wheel of which will weigh 20 tons. Some still more important contracts are pending. In the export line the firm has on its books orders from Mexico, France, Holland, Russia, Cuba, Porto Rico and Hawaii; also, they have made big shipments of hangers, shafting, pulleys, etc., to Australia this week. The amount of work the firm has now on hand is probably greater than ever before.

A tool and supply dealer who does a considerable trade with France, Switzerland and other European countries outside of England and Germany observes that since the advance of prices in the United States the sale of certain lines for export has fallen off very materially. One of these lines is that of small lathes.

An American power-transmitting machinery company has lost a $15,000 order from the north of Europe because of prices and deliveries. The company was so crowded with domestic work that it did not care to offer attractive terms. The contract was given to a party near the home of the purchaser.

MACHINERY EXPORTS FOR THE PAST FISCAL YEAR.

The Monthly Summary of Commerce and Finance, compiled by the Bureau of Statistics, Treasury Department, has just come to hand. It shows that the year closing June 30, 1899, brought gains to the export totals of most of the separately classified lines of machinery as compared with the previous fiscal year. The exceptions were printing presses, stationary engines and shoe machinery. The gain in metal working machinery exports was 40 per cent.

Exports of metal-working machinery for June, 1899, were $609,421; June, 1898, $453,752; May, 1899—the amount has already been reported—$471,445. For the fiscal year ending June 30, 1899, the total is $6,491,586; for the fiscal year ending June 30, 1898, $4,618,683.

Electrical machinery exported were: June, 1899, $218,313; June, 1898, $169,258; May, 1899, $241,103; year ending June, 1899, $2,736,110; fiscal year ending June, 1898, $2,052,564.

Printing presses and parts thereof: June, 1899, $74,825; June, 1898, $56,497; May, 1899, $75,313; year ending June, 1899, $847,006; year ending June, 1898, $874,515.

Pumps and pumping machinery: June, 1899, $225,871; June, 1898, $187,998; May,

1899, $255,547; year ending June, 1899, $2,710,654; year ending June, 1898, $2,023,034.

Locomotive engines: June, 1899, 74 in number, at $719,401 total value; June, 1898, 49, at $454,054; May, 1899, 31, at $211,128; year ending June, 1899, 519, at $4,728,748; year ending June, 1898, 468, at $3,883,719; year ending June, 1897, 338, at $3,225,831.

Stationary engines: June, 1899, 86, at $48,352; June, 1898, 43, at $21,553; May, 1899, 103, at $29,612; year ending June, 1899, 605, at $335,061; year ending June, 1898, 565, at $398,570; year ending June, 1897, 423, at $323,438.

Boilers and parts of engines: June, 1899, $83,077; June, 1898, $47,441; May, 1899, $88,341; year ending June, 1899, $1,132,489; year ending June, 1898, $927,552; year ending June, 1897, $671,901.

Typewriting machines and parts thereof: June, 1899, $235,665; June, 1898, $163,450; May, 1899, $247,787; year ending June, 1899, $2,449,205; year ending June, 1898, $1,902,153; year ending June, 1897, $1,453,117.

Sewing machines and parts thereof: June, 1899, $315,180; June, 1898, $319,935; May, 1899, $327,477; year ending June, 1899, $3,264,344; year ending June, 1898, $3,136,364; year ending June, 1897, $3,340,241.

Shoe machinery: June, 1899, $76,659; June, 1898, $62,852; May, 1899, $65,571; year ending June, 1899, $853,936; year ending June, 1898, $895,788.

CINCINNATI REPORT.

As the Cincinnati correspondent of the "American Machinist" visits one and another of the machinery-building establishments of this city and sees the great number of men hard at work, the machines boxed for shipment, others in process of manufacture, and quantities of castings awaiting their turn to be made into machines, he is impressed with the idea that this is a highly favored city. Machine tools are about the liveliest kind of machinery that is being made here, but the facts that are true of them apply to a greater or less degree to other sorts—sheet-metal working machinery, wood-working machinery, engines and electrical machinery, as well as cruder metal products. In Cincinnati, as everywhere else, a forced respite from business is traditionally to be expected in the hot weather, but this year the precedents have been reversed, over-ruled and set aside.

Foundrymen here are rushed to the utmost of their powers. They are having to contend with the difficulty of securing skilled workmen—or, perhaps, workmen of any kind—and added to this is the trouble in obtaining metal for casting. In pig iron and all forms of finished material the demand is greater than the supply. This fact is quite marked in structural material. The agents for one large mill say that they are out of the market entirely. The report goes that large quantities of material for bridge work will be needed in the near future; but to fill the orders in the desired time will be an impossibility. Bars, plates, roofing sheets and about everything else are alike scarce. An authority, however, pronounces the demand for material for building purposes, locally, not excessive.

The Cincinnati Shaper Company is fully filled with orders. Although export trade continues good, the greater part of this work is domestic.

The Barker & Chard Machine Tool Company has completed repairs of the damage caused by fire in its factory in June, and is now in full working condition. It is having a good rush of business, chiefly domestic, though some is for foreign account.

The Cincinnati Planer Company has been adding several new tools—lathes planers and drills.

Rahn & Meyer Company have moved into their new building, and are gradually getting in new machine tools and other appliances which will largely increase their facilities. The Fosdick & Holloway Machine Tool Company is progressing very nicely with its new building, and hopes to move into it shortly.

Some of the largest orders received by the General Electric Company for street railway and electric light pl nts have come through its Cincinnati branch. Although the business of this branch in 1898 was large, it has been fully one-third greater for the first six months of this year than for the corresponding period of last year.

The Bullock Electric Manufacturing Company has received an order from the "Aberdeen Free Press," Aberdeen, Scotland, for a 50 horse-power electrical printing press equipment. This makes the tenth order it has received from Great Britain for this class of apparatus since the first of the year.

The Post-Glover Electric Company estimates its business in electrical supplies for the first half of this year at 300 per cent. more than for the first six months of 1898.

CHICAGO MACHINERY MARKET.

The number of inquiries which the electrical companies are receiving from manufacturing plants is pronounced most satisfactory. There is, however, some delay in the closing of orders. For this the advance which the makers of electrical equipment have made recently seems to be the chief cause. It is related that among machine and other shops there is a general disposition to go into the question of electrical equipment, but that when the estimates are secured the negotiations are not always followed immediately by orders. This, it is stated, is due to the fact that economies to be secured by way of saving of other expenses are not fully appreciated and that a species of education must usually precede the completed transaction. All this takes time, and hence the adoption of the generator and the motor in the shop is not so speedy as inquiries might suggest in other lines of shop equipment.

The volume of business, however, is not showing any diminution from the very gratifying state of activity that has prevailed through the summer. Both small and large orders have been fairly numerous. The Chicago & Northwestern Railroad Company has finally awarded the contract for the equipment of its Chicago machine shops with motors and generators of about 500 horse-power each to the General Electric Company. The contract of the Cudahy Packing Company plant equipment at Kansas City, involving a 700 horse-power generator and 850 horse-power motors, was secured by the Crocker-Wheeler Company. The latter company also contracted to place in the Warsaw Paper Company plant at Warsaw, Wis., a 200 horse-power generator and a 250 horse-power line of motors. Adams & Westlake, this city, have put in 100 horse-power motors, and more are to follow. The Reynolds & Reynolds Printing Company, Dayton, Ohio, has put in an outfit, and a large steel works at St. Louis is in the market for an equipment of about 1,000 horse-power.

Quotations.

NEW YORK, Monday, August 21.

Iron — American pig, tidewater delivery:—

Pennsylvania irons:

No. 1 X foundry	$21 50 @ $23 00
No. 2 X foundry	20 60 @ 22 00
No. 2 plain	20 00 @ 21 00

Alabama irons for delivery in 1900:

No. 1 foundry	20 50 @ 21 00
No. 2 foundry	19 50 @ 20 00
No. 3 foundry	18 75 @ 19 25
No. 1 soft	20 50 @ 21 00
No. 2 soft	19 50 @ 20 00
Foundry forge	18 50 @ 19 00

Bar Iron — Base sizes — Refined, mill price on dock, 2.18 @ 2.25c.; store price, 2.40 @ 2.50c.; common, from store, 2.30c.

Tool Steel — Base sizes — Standard quality, 6½ @ 7½c.; extra grades, 12 @ 14c.; special grades, 16c., and upward.

Machinery Steel—Base sizes—Ordinary brands, from store, in small lots, 2.70c.

Cold Rolled Steel Shafting—Base sizes —From store, in small lots, 3¾c.

Copper—Carload lots, Lake Superior ingot, 18½ @ 18⅝c; electrolytic, 17¾ @ 17⅞c.; casting copper, 17½ @ 17⅝c.

Pig Lead—Carload lots, 4.60 @ 4.65c., New York.

Pig Tin—In 5 and 10 ton lots, f. o. b., New York, 31½c.

Spelter—Prime Western in carload lots, 5.65 @ 5.75c., at New York.

Antimony—In cask lots and over, Cookson's, 11c.; Hallett's, 9¾ @ 9⅞c.

Lard Oil—Prime city, present make, ice pressed, 42 @ 45c., in wholesale lots.

The Dudgeon Steam Wagon.

This steam wagon was designed by Richard Dudgeon, whose hydraulic jacks, pumps and roller tube expanders have been well known and largely used for many years past.

Dudgeon was of Scotch birth, and began his American career as a day worker in a machine shop, and the bringing of his hydraulic jack into merchantable form placed him in debt, so that he had the usual hard struggle at first, beginning with a little 7x9 shop and not much else besides his hands and his wits and his grim determination to carry through whatever he once began.

Dudgeon's first hydraulic jacks were made in 1850, some fourteen years after Hancock's highly successful coke-fired steam carriages had been driven off the English highways by prohibitive tolls, imposed in the interests of horse-drawn coach owners, and Dudgeon was undoubtedly familiar with the steam road-wagon problems and their various solutions in the form of steam-driven carriages for common roads which cut so large a figure in the few mechanical publications which appeared between 1820 and 1850. As soon as the hydraulic jack was fairly on the market and Dudgeon realized that he had a sure income and could indulge his fancy he began the construction of his first steam wagon, completed it in 1855 or 1856, and had it on exhibition in the New York Crystal Palace, where it was destroyed by fire in 1858. There are now no drawings to be found of the first Dudgeon steam wagon, but it is said by one who saw it to have been substantially of the same design as the curious vehicle here illustrated, which Dudgeon was a long time in completing, so that it was not placed on the road until 1866, all of the work being done in the Dudgeon shops, 24 and 26 Columbia street, except the boiler, which was built by Nichols, Gouverneur street and East River, New York City.

The same simplicity and directness which made the marked success of Dudgeon's hydraulic jack and his roller expander mark the design of his steam road wagon, the general form being that of the single-driven American locomotive, as shown in the "Lafayette," built in 1837, by Norris, using the link in place of hooks for operating the valve. Dudgeon must have been familiar with the work of James, who built some steam road wagons in New York long before Dudgeon began in that line, but there is no trace of the James design in Dudgeon's work.

As shown by the illustrations, Dudgeon placed his wagon on four wheels, the front pair running loose on a pivoted axle, and having a screw and swivel nut for steering, while the rear wheels were keyed to a double-cranked axle, no compensating gear being used. Flat water tanks are carried on brackets at each side of the boiler, and provided with cushions and back rests, to make them serve as seats, and a heavy cocoa-fiber mat laid on top of the boiler serves as the passengers' foot-rest. The naked cylinders, 4-inch bore by 14-inch stroke, are connected directly to the rear axle, and the valves are driven by eccentrics and links, as clearly shown in the illustrations. The tumbling shaft is operated by a hand-bar (see Fig. 5), the tumbling shaft boxes being placed on the front end of the firebox.

The front axle, Fig. 3, is a double iron strap structure, filled with wood, pivoted on a king bolt and provided with a swivel nut which takes a mongrel double-thread

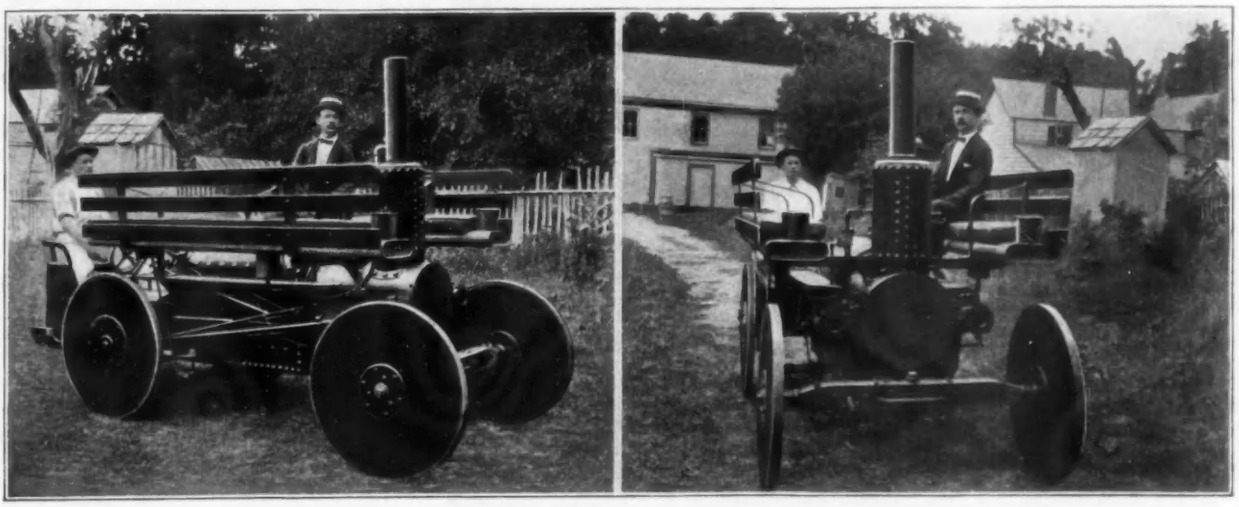


FIG. 1. DUDGEON STEAM WAGON, 1855-56. FIG. 2.

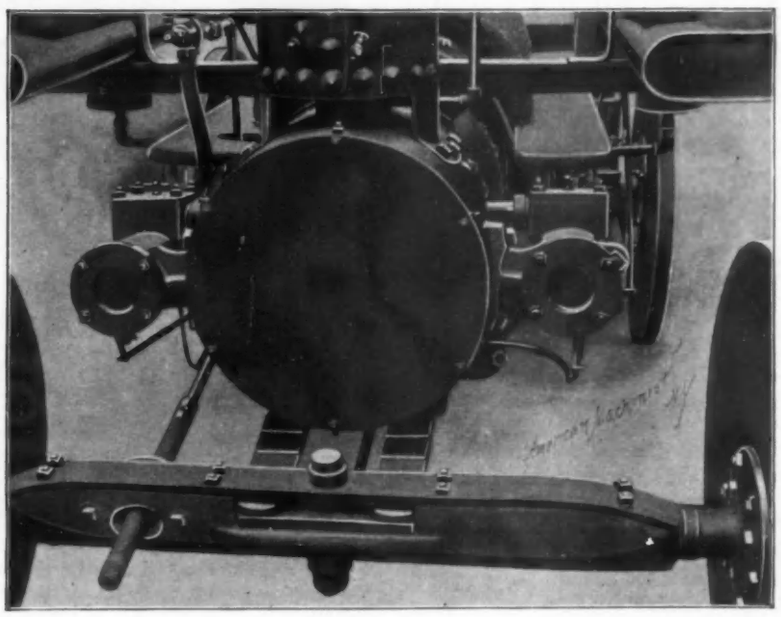


FIG. 3. DUDGEON STEAM WAGON—FRONT VIEW ENLARGED.

screw about 1⅜ inches diameter, operated by a 12-inch hand wheel at the rear end of the boiler, where the driver sits with his feet in the coal box. The barrel of the boiler is about 20 inches diameter, and extends about 16 inches in front of the firebox, which is 44½ inches long outside. The boiler has no dome and measures about 44 inches from the top of the shell to the bottom of the firebox. There is no ash-pan, the grates opening directly to the road surface. The throttle rod runs through the body of the boiler, and is operated by a hand lever just over the fire door, which is circular, and has no hinges, but is supported on a flat spring with a V-bend at each end, one end pivoted to the boiler front and the other to the fire door. To open the fire door the spring is pulled outward and lifted upward, the spring holding the door against the boiler front wherever it is left.

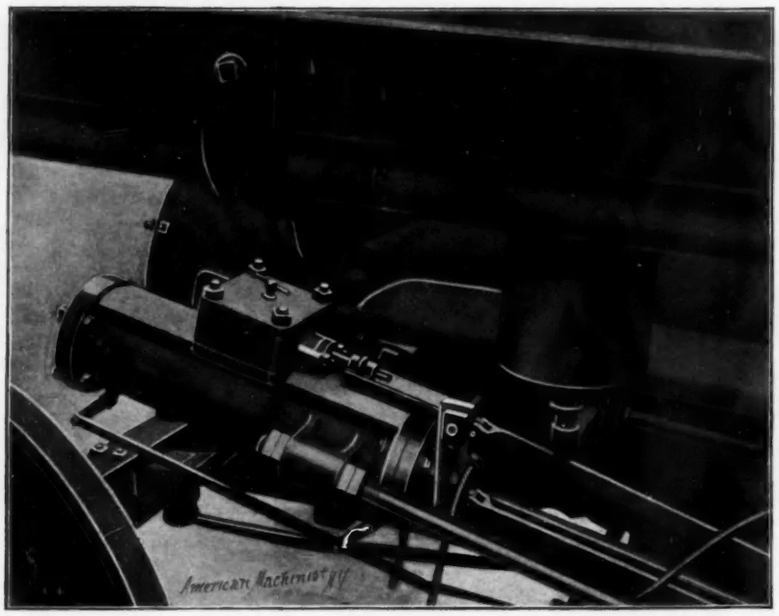


FIG. 4. DUDGEON STEAM WAGON—CYLINDER, LINK, ETC.

The links work on blocks hung on pins in the valve-rod slides, working in ways formed on top of the cylinder side pipes, as in Fig. 4, and there is an outside rod passing from a lug cast on the cylinder to the rear axle box; same on both sides.

As the boiler has no dome it gives very wet steam, and a drying chamber is placed about the up-take (see Figs. 1, 2 and 3), but is not efficient, as it has not enough heating surface, and the wagon, which weighs about 4,500 pounds, takes a lot of water and a lot of fire to make it go.

The wheels are of decidedly novel construction, being made of cedar sectors, held between cast-iron flanges bolted together, and having steel tires 2 inches face by 1 inch thick. This face is far too narrow for the load the wheels have to carry. The boiler feed is by a plunger pump, 14-inch stroke, on the left side of the boiler, and a Hancock inspirator at the right-hand side of the superheater.

The rear wheels are 38½ inches diameter, the front wheels about 37 inches. The rear hub flanges are about 16 inches diameter, and the front about 12 inches. The rear axle, where the wheels are keyed on is about 2⅜ inches diameter, and the wheel base is about 84 inches.

This wagon is about thirty-three years old, and is now in the possession of Frank Dudgeon, a son of Richard, at Locust Valley, L. I. It has seen a great deal of rough service, and was, so far as I could judge, in as good condition as when it first came out of the shop. It will accommodate ten passengers and the driver, and nothing short of collision with a stone wall seems likely to injure it. The wheels showed no signs of the hard work they have had; the tires are worn down about ⅛ inch, but otherwise everything appears to be about as it was at first. The fuel used is hard coal, pea size, and charcoal is sometimes mixed with it. The wagon can make up to 25 or 30 miles an hour. The exhaust is quite noisy, otherwise the wagon is still, as there is no gearing of any description.

The wheels are cheap and durable, which is more than can be said of any other motocycle wheels within my knowledge, and this Dudgeon wagon, taken all together, primitive as it seems at first sight, is not void of suggestiveness. There is a very great field of usefulness for carriages to carry twenty passengers and a driver over short country routes, where a single vehicle could make, say, half-hour trips, covering a route of six or eight miles, or hourly round trips for that distance. There are many places where such a wagon would earn good money for its owner, and it is not at all certain that any other motor is superior to the steam engine for such a service. Of course, naked cylinders, 4 inches diameter by 14 inches stroke, fully exposed to the atmosphere, are not quite the thing, and a loose cocoa-fiber mat is not an altogether satisfactory boiler clothing. But a wagon which can stand thirty-four years of banging around with no particular care has at least the elements of durability in its design, and when mechanical vehicles are used for actual work in carrying freight and passengers through country districts,

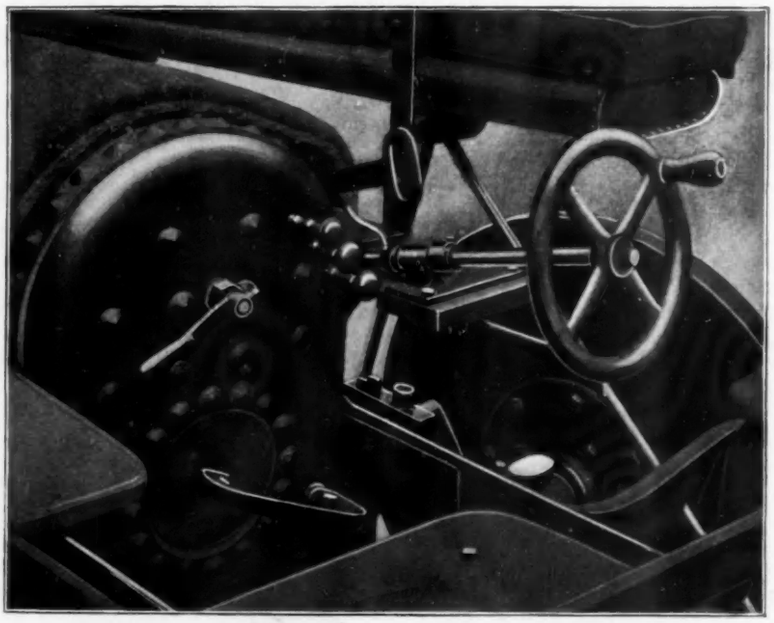


FIG. 5. DUDGEON STEAM WAGON—STEERING WHEEL, THROTTLE HANDLE AND FIBER MAT FOOT-REST.

and their owners and drivers depend on their earnings for a living, durability is going to stand high up in the scale of points of superiority.

I believe that an omnibus to carry twenty passengers and a driver could be built with horizontal boilers, two small diameter shells side by side, so the whole deck of the vehicle and the rear and front end were available for passenger ingress and egress and seating, which would not weigh over 4,000 pounds ready for a day's work on the road and which would run every day in the week for twenty-five years without much repairs, very nearly on the Dudgeon plans, with the cylinders connected directly to the driving-wheel axles.

It is not yet decided whether there is to be one single final type of working, mechanically-propelled wagon or many types, but certainly, in motor wagons, as in all other machines, we may expect simple forms to give satisfactory results for rough work, and no form of motocycle can be more simple or built for less first cost than the direct-connected steam wagon shown in Dudgeon's work of 1855.

We are building electric cabs now to carry two passengers and a driver only, which weigh very close to 4,000 pounds and have wheels that cost a lot of money, and sometimes don't last as many minutes as Dudgeon's cedar-sector wheels have lasted years, and it is perfectly possible to place an omnibus or cab body on such easy springs that wooden wheels and steel tires will satisfy the passengers, and when it comes to making motor vehicles pay expenses and something over, ruining pneumatic tires that cost $50 apiece will not be regarded with favor.

HUGH DOLNAR.

When motor-driven vehicles are thoroughly reduced to practice and can be operated economically, what will be the use of rails and trolley wires in city streets?

The Construction of Switchboards—I

BY WM. BAXTER, JR.

Switchboards designed for plants of small capacity have no particularly interesting constructive features, owing to the fact that small conductors are capable of conveying the current, and these can be made of wire which is readily bent into any desired shape. As a rule the cross section of conductors is estimated so that the current density will be from 600 to 1,000 amperes per square inch. If the capacity of the plant is not over two or three hundred amperes it can be readily seen that the various connections can be easily made by running two or three copper wires of large size side by side. If the electromotive force is 220 volts, which is the pressure most commonly used, the power may be estimated roughly as equal to one horse-power to every four amperes; hence, 200 amperes would represent fifty horse-power. If the capacity of the

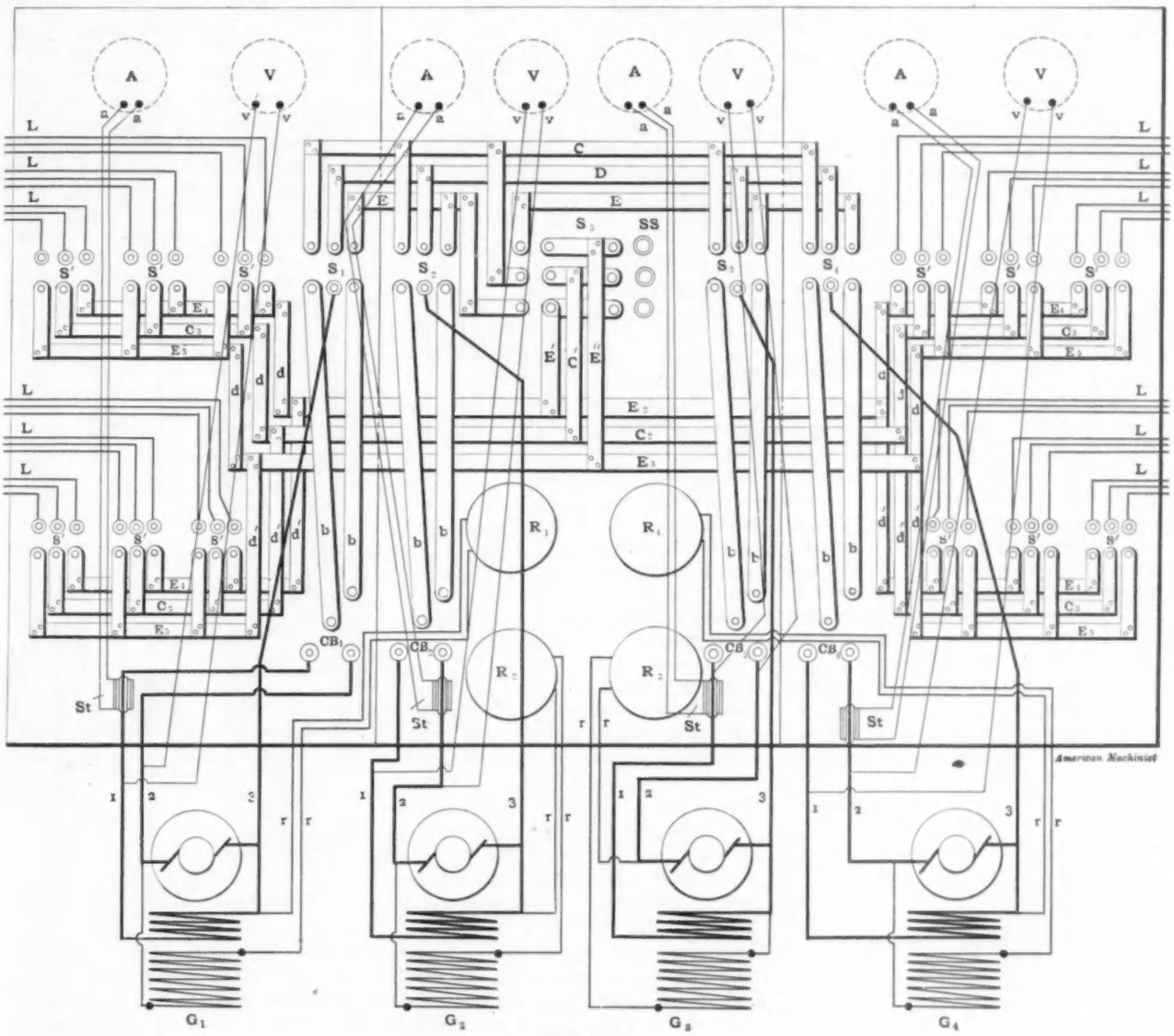


Fig. 1

SWITCHBOARD CONSTRUCTION.

plant is 500 horse-power, the amperes will be about 2,000, and the cross section of the conductors will have to be from two to three square inches. In manufacturing establishments 500 horse-power is not considered a large plant; in fact, it is smaller than many, the capacity in some instances running up to several thousand. From this it will be seen that in electrical installations such as are required for large manufacturing establishments the currents handled range all the way from, say, 1,000 amperes up to 15,000 or 20,000, and in some cases may go far beyond this point, if the voltage is very low, as is frequently the case where the current is used for electro-chemical operations. If we estimate the cross section of the conductors at the rate of 1 square inch per 1,000 amperes, then the range of cross sections for the switchboards of industrial installations will be from 1 to 15 or 20 square inches. Unless the current is used for chemical processes the cross sections will not very often run beyond four or five inches, for when the power transmitted is very great the voltage is increased, and thus the current strength reduced.

For any size of conductor greater than one-half of a square inch, flat bars can be used to better advantage than round wires, and they are more desirable from an electrical point of view, as they present a greater radiating surface for the same cross section, and therefore will not heat up to the same extent with a given current strength. The general arrangement of these connecting bars is shown in Fig. 1, which represents the back of a switchboard arranged for four generators, each one having a capacity of 1,000 amperes, making 4,000 amperes as the total capacity of the board. The connections between the generators and the board are shown in single lines, but these are made with cables, or bars, whichever may be the most convenient. The conductors 1 2, of each generator, run to the lower terminals of circuit breakers, which are marked $C B_1$, $C B_2$, etc. The conductors marked 3 are the equalizer connections, and run to the lower center terminals of the switches marked S_1, S_2, S_3, S_4. The bar D is the equalizing bus, and the bars C and E are the positive and negative buses, and to these the current passes from the outside terminals of the switches, these being connected with the center and top terminals of the circuit breakers by the bars b b. This board is arranged so as to distribute the current of the generators, or to obtain a supply from the street mains. The switch S_5 is for the purpose of connecting the bars E_2, E_3 C_2, which are the main distributing buses, either with the generator buses C E D or with the street mains, which come to the three terminals in the vertical row marked S S. The switch S_5 is double throw, and when thrown to the left connects the generators and the main buses, and when thrown to the right connects the street mains with the main buses. The main buses, at both ends, connect with secondary buses E_4 E_5 C_3 by means of the bars marked d d d and d' d' d'. From these secondary buses the current passes by means of the distributing switches S' to the external circuits L L L.

The ammeters are of the shunt type and derive current from the top and bottom terminals of the ammeter shunts marked St. The voltmeters are connected with the lower terminals of the circuit breakers or with any convenient points on the wires 1 2 leading from the generators. As the ammeters and voltmeters take very small currents, the connecting wires are small flexible cables.

As a rule all the connecting bars are made straight and are run at different distances from the back of the board, so that they may cross each other and leave a sufficient intervening space to render accidental contacts improbable. The cross section, Fig. 2, shows the location of the main bus bars E_2, E_3 and C_2, and also of the secondary buses E_4, E_5 and C_3. The positon of the connecting bars d d d and d' d' d' is also shown. Owing to the fact that the different bars are run in separate planes, the studs which form the terminals of the switches and circuit breakers and to which the connecting bars are attached, must be made of different lengths or else be long enough to reach the most distant bars. The latter construction is generally followed, and in order that the studs may be adapted to hold bars at different distances from the back of the board, they are threaded throughout their entire length, and are provided with three nuts, one of which clamps the stud to the board, the other two holding the bar, as is shown in Fig. 3.

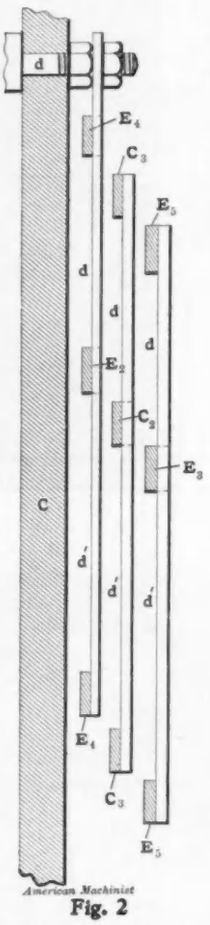


Fig. 2

ARRANGEMENT OF CONNECTING BARS.

The generator buses E D C have to carry currents of 2,000 amperes, owing to the fact that the switch S_5 is located at the center. If this switch were placed at one end, then these bars would have to be of sufficient size to carry 4,000 amperes. Thus it will be seen that by properly locating the switches the size of the connecting bars can be reduced. The main buses E_2, E_3 and C_2 are also arranged so that one-half the current runs in each direction; therefore, they need only be of sufficient capacity to carry 2,000 amperes. The bars leading down from C D E, and up from E_2, E_3 and C_2, to the throw-over switch S_5 must be of sufficient size to carry the whole current. The bars d d d and d' d' d', and also the secondary buses, are made of a cross section sufficient to carry 1,000 amperes. From the foregoing we see that the bars connecting with switch S_5 should have a cross section of 4 inches, but as they are very short we can safely reduce it to 3 inches. The generator buses C D E and the main distributing buses E_2 E_3 C_2 must have cross sections of 2 inches, and the bars d d d and d' d' d' and the secondary buses E_4 E_5 C_3 must have cross sections of 1 square inch.

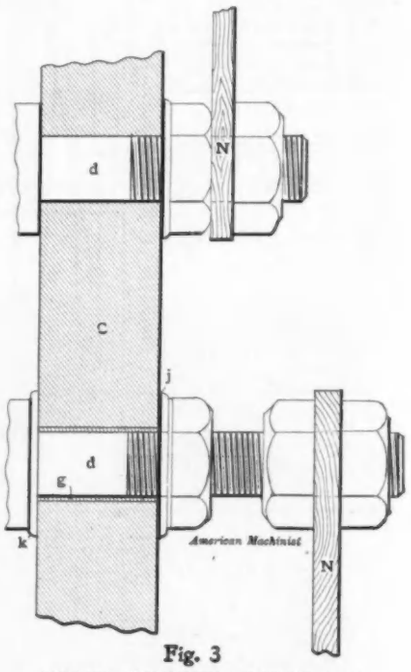


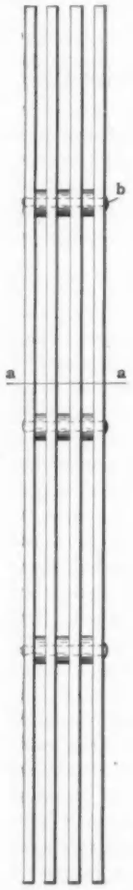
Fig. 3

SUPPORT AND INSULATION OF BARS.

When the cross section of the bars is small they are made of a single bar, but when the cross section is large they are generally built up of several thin bars separated from each other as shown in Figs. 4 and 5, the latter being an enlarged section through a a of the former. This construction is resorted to for the purpose of reducing the cross section. When the current to be carried by a conductor is small the size of the bar required may be too small to give the necessary stiffness, and on this account the carrying capacity is estimated at the lowest limit, but when the current is large there is no lack of mechanical strength, and then as the size of the bars begins to seriously increase the

cost of the structure, the carrying capacity is estimated at the highest limit. For example, if the current is, say, 500 amperes, the bars may be calculated on a basis of 600 amperes to the square inch of cross section, but if the current is 4,000 amperes the bars will be estimated on the basis of 1,000 amperes per square inch. In the latter case the increased current density will result in generating more heat, and in order that the temperature of the bars may not rise to such a degree as to materially increase the electrical resistance they are laminated so as to increase the radiating surface; hence the construction shown in Figs. 4 and 5.

If Fig. 1 is closely examined it will be found that all the bars are supported by means of the connections made with each other and with the terminals of the switches and circuit breakers. Thus the generator buses *C D E* are held by the connections with the four main generator switches and the connections with switch S_1. All the other buses and connecting



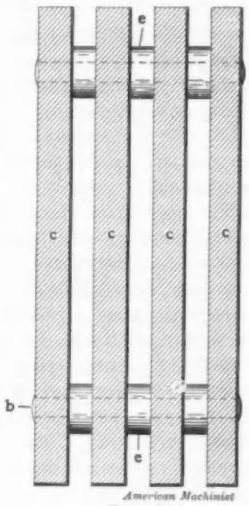


Fig. 5

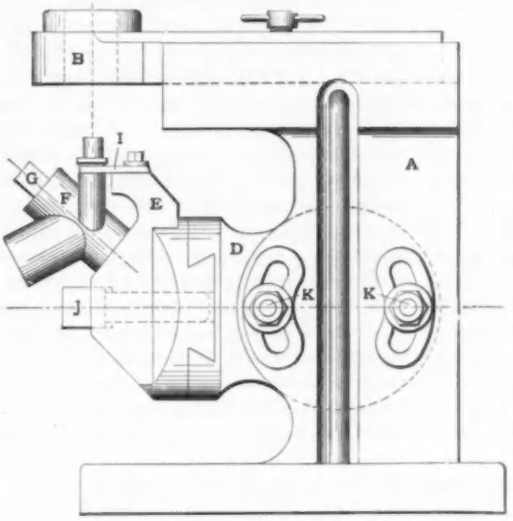
Fig. 4

MULTIPLE BARS FOR LARGE CURRENTS.

bars are held by means of the connections with the distributing switches S', and also by the connection with the switch S_2, this latter attachment serving as a support for the center of the buses E_2, E_3 and C_2. The effort of the designer should be directed toward so disposing the switches and instruments with which electrical connections have to be made that these connections will afford all the support the connecting bars require. There are very few instances in which a skillful designer cannot accomplish this result without in any way interfering with the proper location of the several devices. But when it becomes necessary to provide additional supports these must be of such a character as to insulate the bar from the switchboard, not only from the metallic parts thereof, but also from the slate or marble slabs which constitute the surface, although attachment to the marble slabs without insulation may be made if the voltage is not over 110 and the installation is of small capacity, say, under 100 horsepower. Marble and slate are generally good enough insulators to hold the circuit connections without further insulation, providing they are dry, but in damp weather their insulating qualities cannot be depended upon. On account, for voltages over 500 the switch, circuit breaker and instrument terminals should be insulated from the board by means of sheet mica washers and tubes, as shown at *g k* and *j* in Fig. 3.

The frame *A* carries an adjustable slide *B* for moving the bushing forward or back; also a sub-frame *D* carrying another sliding piece *E*. *D* swivels on the solid post *L*, a part of *A* being held in position with the bolts *K K*. The different positions of the parts when once made for different operations are carefully marked so that resetting for any part of the work is easy. The work being handled in lots, resetting is but little trouble.

H, Fig. 3, is a post with an expansion screw *G* for holding the work, and *I* is a sliding gage for locating the arms of *F*, first for one side and then for the other. The set screws *C* and *J* secure the sliding pieces *B* and *E* in position very effectively and simply by bottoming on the castings *A* and *D*.



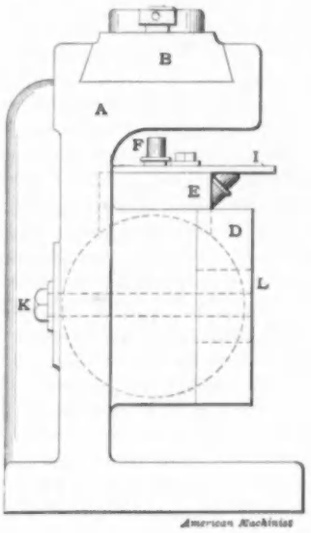


Fig. 1 Fig. 2

AN ADJUSTABLE JIG.

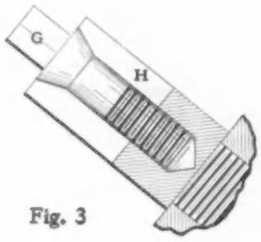


Fig. 3

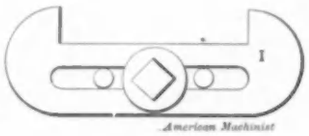


Fig. 4

An Adjustable Jig.

BY A. H. CLEAVES.

The jig described in this article is for doing work on the bicycle part known as the seat-post union, and is so constructed as to get the cuts on different sized pieces, and also the different cuts on the same piece with one jig. This jig was designed by Mr. J. R. Foster, the foreman of the machine shop in the Peoria Rubber Company. Anyone familiar with the requirements in this will appreciate the ingenuity displayed in providing for the peculiar difficulties presented by the angles of the piece F. The drawing describes the jig pretty completely, but a few parts may be mentioned.

I intended to mention in a former article that the band saw blades used in the manufacturing department, after being dulled somewhat for that class of work, do good service in the machine shop, being used in a Stover Novelty Company's hack-saw machine.

This is provided with a box for holding a continuous saw blade, and while it is

not so rigid as some other machines and does not cut off large work so straight, is very convenient for smaller work, and the saws mentioned are broken off and moved along with the least inconvenience.

Peoria Heights, Ill.

Gear Teeth.

BY W. H. BOOTH.

I must confess to being a good deal puzzled about the various statements made from time to time in American journals on the subject of gear teeth in respect of the method of stating pitches per diameter. It appears to be thought that the system is not known or used here, whereas the method is very old, and diametral pitch is always spoken of, as stated in the "American Machinist" of May 18, as Manchester pitch; probably because the system originated there. Thus a 10-pitch wheel would be one of such pitch that there are ten teeth per inch of pitch line diameter. A wheel of 10 inches diameter would thus have 100 teeth, and its circumference being 31½ inches nearly, the circular pitch would be about 3-10 inch. I do not know that the system has ever been much used outside the ranks of the toolmakers or other makers of wheels with small teeth. But I do not think that this can be said to mean that other engineers make their wheels of odd diameters. Let us suppose that an engineer wishes to make a pair of wheels. His idea of the strength of tooth necessary is such that the circular pitch should be 1½ inches. He wishes to have a wheel 40 inches diameter. The circumference of a 40-inch wheel is approximately $40 \times \frac{22}{7}$, or nearly 126 inches. Then 252÷3 is 84. This is the way followed in practice, because it is easier to divide 3 into 252 than 1½ into 126. Then 84 teeth in a 40-inch wheel will have a circumferential pitch of nearly 1½ inches, and according to the requirements as to relative velocity the number will be just this, or it may be 85 or 83, according to strength. As to the use of circular pitch producing a fractional diameter, is not Mr. J. Richards a little hypercritical? Let us assume that, having obtained our 40-inch diameter wheel, we now wish to find a pinion to be driven at one-fourth speed. In a machine tool where perhaps an exact ratio of 1 to 4 is imperative, we do this easily and use a 10-inch diameter pinion and twenty-one teeth, and the ratio $\frac{84}{21}=4$. But this is bad practice in general work. Let a pump be supposed. We must have a hunting tooth. To run with an 84-tooth wheel the pinion must not be of 21 teeth. It must be either 20 or 22, or it may be 19 and 23. There is only partial hunting in the first two alternatives and in all the ratio is rather wide of the requisite 1:4. We must therefore make the wheel with either 83 or 85 teeth and the pinion with 21 teeth, and we can thus have either a ratio of 1 : 4.047 or 1 : 3.952, both very close to the desired ratio. But while the diameter of the wheel will be 40 inches, that of the pinion will be either 9.88 or it will be 10.12 inches. Here then we have a very fractional diameter, in the choice of which the pitch has had nothing to say. In the old days of mill gearing cast from wooden patterns, when there might be a dozen or twenty different patterns in one "set," the use of a fixed pitch was good practice, because there would be at most one wheel in a set of a diameter in whole numbers of inches. All the rest would probably be fractional, and it was sound sense to keep even numbers for the pitches. Now that wheels are molded by machinery and patterns are cheap things of a couple of teeth only, wheels can be ordered of any diameter, and in my own practice I take no notice of the pitch or of the diameter further than I find out approximately the pitch suitable for the work to be done. I then fix upon the distance apart of the shafts, and I order from the wheel founders a wheel and pinion in this form: Wheel 89 teeth x 5 inches broad; pinion 18 teeth x 5 inches broad; 25 inches joint radius. Then I cast a girder frame and bore out the bearings exactly 25 inches apart, and I obtain a pair of wheels having the ratio I desire and suitable to run well together with close hunting of one tooth, and I specify the breadth and the bored hole, but neither myself nor the founder needs to calculate the pitch. The molding machine is set to the requisite radius and the change wheels are put on to divide the circle into 89 equal arcs and 18 arcs. The wheel maker simply calculates the two radii, which are $\frac{89}{107}$ of 25 inches and $\frac{18}{107}$ of 25 inches, the number 107 being 89+18.

For general engineering I consider this system to be the best, because it throws on the wheel maker, who is always working to fractional radii, the dividing up of the joint radius in proper proportion, and it leaves the pump maker exact distances for boring out bearings, which is desirable when these are gun metal cylinders placed in bored out plummer blocks cast solid on the girders. It appears to me that even dimensions for the distance apart of the shaft centers are more conducive to general convenience and accuracy than is an even diameter of one wheel. Where the wheels have exact ratios, and both have a diameter expressible in whole numbers, this still leaves the joint radii a whole number, and altogether in general work it is not necessary to take notice of pitch, except so far as strength is concerned. Before the days of dividing machines, however, pitches were perhaps best made non-fractional, for in the making of a pattern each tooth had to be stepped out by compasses—a tedious piece of work. The dividing machine does this to-day, and requires no pitch to work to. It simply divides a circle into so many parts and can equally produce a tooth having a pitch in whole numbers, or one with a million figures behind the decimal point.

[We think it is generally understood among well posted American mechanics that the diametral pitch system originated in England many years ago. It is probable that, at bottom, the reason for its more extensive use here lies in our greater use of cut gearing, for which in small sizes it possesses decided advantages. Added to this, when the Brown & Sharpe Manufacturing Company entered upon the systematic manufacture of gear cutters, they adopted the system and published in their catalog a list of simple formulas adapted to it, and thus put in the hands of everybody the information necessary for applying the system to actual cases. One of the things that surprises American mechanics is the small amount of space devoted to the system in English reference books. Two recent English mechanical engineers' pocket books have been noticed in these columns in the recent past, in which no reference to the system was made.—ED.]

Typewriters Signs of Prosperity.

As an illustration of the substantial increase in business, the local manager of a standard typewriter machine declares the various companies did a greater business in the six months ending June 30 than for any previous six months in the history of the typewriter trade.

"The significant thing about it," said the manager, "is that the typewriter is an index—a barometer in commerce. Business men do not buy machines unless their business warrants it. It is the one thing that never goes into an office until the demand for economizing time becomes urgent. No agent can sell the machines to a man unless the business is of a permanent character. That is the value of typewriters as indicators. Merchants and manufacturers and all the rest of them know pretty well whether the rush is of the substantial and lasting kind, or if it is likely to fall away in a month or two. And if the latter threatens, they couldn't be induced to buy, no matter what was said to them. But if business promises to hold and seems likely to grow, they want machines. In the years when typewriter sales are largest look for better business through the year and through the succeeding year. As I say, more machines than ever before for the same length of time have been sold in the last six months."—"The Chicago Post."

Traveling Engineers' Association.

The seventh annual convention of the Traveling Engineers' Association will be held at the Grand Hotel, Cincinnati, O., commencing September 12. Full information regarding the the convention may be obtained from W. O. Thompson, secretary, 415 Union street, Elkhart, Ind.

[A Logical System of Wages.

BY JOHN RICHARDS.

It is proposed in this article to deal with the wages problem from a "shop" standpoint, in a purely practical way, but it seems necessary at the beginning to discuss some of the relations of skilled labor to other elements of production. This portion will be made as brief as possible, and while many of the suggestions made will be of a general nature, they will be especially directed to machine works for producing organized articles, such as engines, machine tools and like products that can be classified and divided as "jobs" in a works.

As an explanation of this rudimentary treatment of the subject it may be mentioned that the suggestions offered are such as are derived from practical experience and observation in the works.

The nature and relations of wages as an element in industrial production, like most other economic problems, has undergone a wonderful amount of discussion without settling down into any accepted theory simple enough for popular understanding, or that has found acceptance with practical people. Capital, another component or factor in skilled production, has gone through a similar maze of discussion by economists, ending in the same sort of chaos down to 1880, when a practical man* of then unpretentious position as an economist, solved this problem of "What is capital?" by saying, "Capital is simply what is written in a capital account." This was turning from the labyrinth of speculative philosophy to the plain field of actual fact. It was distasteful to economists to have their labored theories of capital thus reduced to a plain matter of fact, comprehensive to anyone, with no chance of refutation. It was a *reductio absurdum* of their labored efforts, but was true and all that we needed to know of that problem.

The accounts and records of business are its laws, show its nature, relations and foundation, so to speak, and when these declare unmistakably what capital is, as every set of properly kept books must do, that is the practical "fact," and whatever anyone may conclude besides, is of no consequence.

Wages as an element in industrial production are capable of analysis in the same manner, by reference to the facts of actual practice as shown by business records and accounts, which are an essential portion of practice.

The total cost of skilled products of every kind is made up of five elements or components, namely: Interest on capital, labor, material, expense and profit. Profit is included because without this as an incentive nothing would be produced. Capital, as explained, is what is written in the capital account, that is, the fixed agents of production, not merchandise or material. Capital may, in a sense, include a fixed sum of money, or more often a credit, to bridge over the period of construction as an advance or loan, but such capital or credit goes into merchandise. For example, suppose that the pay-roll of a works amount to $5,000 per month and that an inventory is made on the first day. During the month $5,000 will disappear in wages, but another inventory at the end of the month will show the wages converted into merchandise, sales and profit. The wages are in fact a credit component in the course of the business, because not paid until their product is placed in possession of the owners.

Owners furnish capital or plant, what stands in the capital account, also material and expense, while the workmen furnish merchandise, and in a sense profit, because the first named components are commonly entered at their net value and labor at an estimate that covers profit, in whole or in part. From this it will appear that there is a mutual interest or even a kind of partnership between owners and skilled workmen and that both should naturally have the same objects in view; that is, the successful conduct, good will and profit of a business. This is not, however, the case. Workmen are commonly endeavoring to raise their wages and owners as commonly trying to lower the rate. There is a continued contention going on that has its cause and foundation in circumstances that certainly should be ascertainable.

At this point it would be easy to enter upon the worn-out and useless arguments of an ethical nature that make up endless essays on labor and wages. Even the latest and best essays, for example, those of Dr. Lujo Brentano on "Hours and Wages in Relation to Production," as well as his former work on the legal relations of labor (1891)*, show throughout a kind of tendency to treat the labor problem on social instead of business grounds, and while he establishes beyond doubt, as Schoenhof has done before, that a high "rate" of wages produces a low "amount" of wages or cheaper production, he fails to point out the true incentives that lie behind skilled labor, or, in other words, the shop conditions under which it is performed. It is not a disparagement of Dr. Brentano's writings to make this statement. He easily stands at the head of modern investigators of the labor problem and has rendered services of inestimable value.

The efficiency of skilled labor, or the measure of effort in such labor, is "responsibility." As a man is responsible and as he is a free agent he becomes reliable and useful. Responsibility may be pecuniary or it may be moral—money or manhood, we may say—and it is to this fact we must look for a solution of the skilled labor problem. The work must begin in the shop and not in essays and moral homilies on the moral economic relations of labor.

Labor is performed under four conditions, namely: (1) Slavery, in which the workman is a chattel and without personal rights; (2) Time work, in which workmen are paid definite wages for an indefinite amount of work; (3) Piece work, or individual contracts, possible only in producing duplicated commodities; (4) Co-operative contract work, whereby all the men in a works receive wages in proportion to what they produce, and are collectively responsible.

These four systems comprise our present methods of compensating labor, with "time work" predominant in this country. Time work ranks next to slavery, because it relieves workmen of responsibility and places them in a dependent position. Their wages become an accident and have no specific relation to product or profit—a system under which workmen and their employers occupy what soon become antagonistic positions. What one gains the other loses. The business itself is to the workmen an extraneous matter, with which they have no direct personal concern, and in which they have no responsibility. They will shift from one shop to another, looking on all as places from which they can draw wages for "time" service, and the main incentive to work faithfully is in many, if not in most, cases a fear of being discharged.

It is a great credit to the mechanics of our day that by time work and such a relation to their employers they render in most cases faithful service. In the abstract such a system seems as impracticable as it is illogical, and in it will be found, when investigated, the prime cause of what we call labor disturbance in skilled industry.

The individual piece-work system is discriminating, sets up an inequality of conditions in a works and is unpopular among workmen for this reason. It is a step in the right direction, because it makes some men responsible, but it has no reason for existence in modern skilled industry when a general and better system is possible, one in which all the men in a works participate equally.

A CO-OPERATIVE CONTRACT SYSTEM.

To make plain what is meant by co-operative contract work an example case will be assumed, and its nature, practicability and advantages afterwards discussed.

Suppose that in a works a steam engine or other machine is to be estimated for and constructed to original plans. The first thing to be done after drawings are prepared, or furnished, is to, as the English call it, "take out the quantities," that is: First, ascertain the weight and cost of all the material; second, compute the amount of labor, or the wages for con-

* Henry George, 1880.

* Scribner's (translation), 1894.

structing the machine; third, estimate the amount chargeable to expense; fourth, determine the amount of profit that should result from the contract.

These components make up the total estimate for the machine, which, if accepted by a purchaser, becomes an order and is put into the works under a symbol number, 100 for example. The foreman and workmen are furnished with copies of the drawings and of the specifications, so far as these affect the work; also, with an estimate for the work or wages, which the men will compute and see if it is in accordance with the rules and the estimate a fair one. If there are objections, these can be stated and corrected; if there are no errors, the work is accepted or passed in the shop and construction begins.

On all the drawings and orders for supplies that constitute merchandise entering into this machine is marked the symbol 100, and the men enter on their time cards all the time given to this number, whether it be in the pattern shop, foundry, finishing or smith shops, and this time is charged by the timekeeper each day to 100, until the machine is completed. Then the whole of this time is assembled and multiplied by the wages rate of the men and compared with the original estimate, to see if there is a surplus or a loss on the labor account. The men are paid weekly regular wages at rates corresponding to their skill and as agreed with the owners. This rate is also posted or made known in the works, and the sum of all the wages for the time spent on No. 100 is deducted from the original estimate for wages, and the surplus if any is divided *pro rata* among all the workmen in proportion as they spent time on "100."

The labor estimate may be $2 or $2,000. It makes no difference. The result will be the same and time work will be eliminated for all workmen in the works, unless it be a few laborers, whose wages are commonly charged to the expense account.

Before proceeding to discuss the practicability of this co-operative contract system and its manner of operating in a works, it will be proper to explain that nothing new is proposed, and that the writer has not added or suggested anything not now done and practically carried out in hundreds of works where this system prevails, and where its effect can be seen in various beneficial results.

Proceeding now to consider the practical working of this co-operative system, the first impediment that will occur to those who have not seen it in practice will be the estimates for labor or wages. This is the key to the system. It presents no difficulty in its application, but a good deal in its "evolution." In a works where such estimates are made up there is soon collected all the required data from which the estimate work can be done readily and uniformly.

Casting is put in two or more classes and estimated by weight. Planing is estimated by superfice, 100 inches being the common unit, and divided into rough, beveled or finishing surfaces, under-cutting and water-cutting. Turning and boring are estimated by length and diameter and are divided into classes.

The following lists were taken from the schedule of a machine tool works at Manchester, England, sixteen years ago, the rate in pennies being doubled for cents. These rates are, no doubt, much changed by this time, but will serve to illustrate the system.

PRICE IN CENTS FOR FINISHING SHAFTS TO GAGE SIZE.

Diameter in inches.	Length in Inches.						
	6	12	18	24	30	36	42
1	4½	4¼	4	4	3½	3¼	3
2	9½	7	7½	7¼	7¼	6⅜	6
3	12	11½	11	10½	9¾	9⅜	9
4	15	14½	14¼	13½	13¼	12¾	12

The rate beyond 42 inches is uniform.

PRICE IN CENTS PER FOOT OF LENGTH FOR CUTTING LEAD SCREWS FOR ENGINE LATHE.

Diam. of screw in inches	1¾	2	2¼	2½	2¾	3	3¼	3½	3¾
Price in cents per foot of length	28	30	30	30	34	38	42	46	50

These screws are of soft steel or refined iron with square threads or those called half-angular.

PRICE OF TURNING CAST IRON PULLEYS.

For pulleys from 6 inches to 10 inches diameter, two lathes being furnished, $1.68 for each 100 inches of surface. When pulleys have wide faces, exceeding one-half their diameter, 10 per cent. additional is allowed. Convex and flat faces are the same; the lathes having angular feed in the tool slides, the work is the same in each case.

BORING PULLEYS TO GAGE SIZE.

Price in cents for each pulley.

Diameter of holes in inches	1½	1¾	2	2¼	2½	3	3¼	3½	3¾	4¼
Price for small pulleys	5	7	8	12	17	...	...	...	...	...
Wide face pulleys	24	24	24	24	31	38	41	44	58	62

Boring pulleys is now done on special machines at one-half the prices given. Pulleys are bored in this country at less cost. The turning is also done here for less.

PLANING LATHE BEDS.

Per superficial foot of planed surface.

10 ft. and less	32c	40 ft. to 60 ft.	24c
10 ft. to 20 ft.	30c	60 ft. to 80 ft.	20c
20 ft. to 40 ft.	20c	80 ft. to 100 ft.	16c

SPECIAL PLANING ON MACHINE TOOL WORK.

Price in cents for each 100 inches of surface.

Compound Rests	44	Planing Mach. Tables	12½
Head Stocks	30	Racks	14
Saddles	48	Uprights	41
Radial Drilling Machine	50	Cross heads	25
Planing Machine Beds	17	Tool boxes	36

The planing for shaping machines is set down at 17 cents per 100 inches for frames and tables, 36 cents for undercutting, and 29 cents for rams and saddles.

Surface plates are prepared at 96 cents per 100 inches. Double plates 120 cents per 100 inches.

Apprentice labor in these works is estimated at a uniform rate of five-eighths; that is, their proportion of surplus earning is estimated on five-eighths of their wages rate.

The estimates for labor, also for material, are made up by "quantity clerks," or apprentice draftsmen, with the aid of computing tables, and in a business where duplicate articles are made, as in a machine tool works, it must be remembered that one estimate is all that is required for any number of machines of the same kind.

A second impediment to this system that will be imagined is, that the workmen will object to the estimates and endeavor to increase the rates. This is not the case where the contract system is in use. The rate becomes fixed. The rates for the labor in a district where analogous branches of work are carried on arise out of a consensus of opinions, facts, and experience in different works. It is a subject well known and carefully considered among both workmen and owners, also is one that neither can afford to wrangle over for reasons that will hereafter be explained.

We will now turn to the practical or working results of this co-operative contract system.

(1) The industry and best efforts of the men are insured, because they themselves see that no one receives a rate above his proficiency or class. If a man spoils work or is receiving a higher rate than he should, the surplus wages are reduced accordingly, and the case is soon adjusted in the shop without the management being drawn into the matter.

(2) It insures against "scamp work." If bad work is done, its correction is a loss to all engaged on the job, and good care is taken to avoid anything like bad fits or other defects classed under the head of "scamping."

(3) It permits in many cases charitable treatment of men who are unfortunate, and creates among the men a feeling of co-operation and mutual dependence that has a happy effect in various ways.

(4) It elevates the position and relations of workmen and brings them into sympathy and harmony with their employers and the business, the men well knowing that an abuse of their part of

the contract would soon lead to loss and suspension of a business.

(5) It leads to a close scrutiny of the merits of the tools and implements employed, and to a general rating of the capacity of lathes, planing machines or other tools. A "day's work" becomes a known quantity instead of a myth, as it generally is when men are paid for their time only.

(6) It dispenses with the spy system of maintaining among the workmen foremen representing the owners, nominally to direct the work, and so far not objectionable, but also to watch the men and get out of them as much as possible in the "time," thus setting up a mischievous and false inference as to the relation between the workmen and the business.

(7) It assumes a regular and fair profit on all the work produced, leads to uniform estimates in competition, and raises the standing of a business, makes the owners responsible, and does away with the tricks of cheap work by standardizing quality.

(8) It usually diminishes the cost of production, as can be seen in the fact that workmen in the English machine-tool business earn about double what Continental workmen do, and work only fifty-four hours a week instead of sixty hours, or even more, as is the custom in France, Germany and Belgium. More than one English firm who have started branches on the Continent, especially in Belgium, to avail themselves of the apparently lower rate of labor paid there, have failed in such undertaking and given it up; notwithstanding the Continental branches were relieved of a large part of the expense account because of drawings, special tools, cost of selling and knowledge of processes that came almost free from the parent works in England. The main difficulty was that Continental workmen were not educated up to the contract system, and lacked the productive energy and skill that arises out of the method.

The writer some years ago passed through the Cornwall Iron Works (Messrs. Tangye Bros.) at Soho, near Birmingham, in England, in company with Mr. George Tangye, general manager of the works, and remarked upon the assiduous and uniform energy of the workmen without any apparent means of control or supervision. Mr. Tangye's answer was that among the 2,000 men, then working, not one was paid by time. "Not a screw-bolt," said he, "is made on that system. At luncheon you can learn more of the matter from the office people."

The luncheon was served in a department of the works where all the office force, about fifty men, assembled. Mr. Tangye took the head of the table, and a fine luncheon was served by the works. During the meal, or for half of the time, conversation was general on any topic that came up, and then another half hour was given to a discussion of the business—ways and means, faults, improvements, new inventions, and so on.

There was perfect equality. Mr. Tangye was, I think, the plainest dressed man in the room, and his attention was given alike to the assistant manager and junior clerks. In a subsequent conversation Mr. Tangye said, "The works is a co-operative democracy. Outside the works there are, of course, the usual social distinctions, but these have nothing to do with the business here."

The workmen had their dining room provided by the works, warmed, kept clean and provided with cooking ranges and other conveniences. The works had two physicians, a library, a beneficial fund —was, in fact, a self-contained community of an intensely democratic nature. In 1867 the Tangye Bros., four of them, were paying £50 a year for rented premises and power in Birmingham. Twenty years later they had 2,000 men, and now have more than 3,000, without having ever gained a dollar except from regular profits arising out of their business.

What time-work system can compete with one like this? In a century from now the Cornwall Iron Works will be there; descendants of the present people will own and manage; everyone from the highest to the lowest position will have the same purpose in view—the success of the business.

These works are but one example out of a hundred more that could be named in various branches of manufacture, as at Besbrook and Inchicore in Ireland, at Saltaire and a dozen other places in the Lancashire district of England, many of them well known in this country.

Co-operative trading, by means of which workmen save at least one profit on their supplies, while not a direct, is, nevertheless, an indirect result of the responsible system of labor, and is born of the co-operative spirit that grows out of "responsibility."

It was stated at the beginning that the co-operative contract system would be considered only in respect to organized machine work, and this is perhaps as far as the subject should be treated in the present case; but any reader will at once inquire why any method of compensating labor should be confined to machine work. It is not so confined, and is equally applicable to any kind of industrial product that can be measured and form the basis of agreement. Its earlier and more complete application to machine making is because the product is in units of definable value, and its components quite constant in price, but mainly because workmen in this industry are particularly well informed and capable of understanding the "quantities" and "equities" dealt with.

There are in some cases co-operative wages systems in this country; one at the great Baldwin Locomotive Works in Philadelphia, where there was an acrimonious strike about twenty-five years ago, but the owners, instead of engaging in a war with the men, "wrote a book," or had it written, to explain the relations of labor to the business, and adopted some system, not given to the public, that has worked harmoniously ever since.

Unserviceable Inventions.

BY W. E. WILLIS.

So long as hope springs eternal in the human breast, so long as mankind are ambitious to improve their material condition, or so long as inventors, those "who seek to add their part to the progress of human happiness, knowledge and power by improvements on things existing or new departures on untried lines," exist, so long will inventions be produced, be they wise or otherwise. That the object sought is usually of a mercenary character will be conceded; that the results attained are largely financially unfortunate is due to a number of causes not difficult to suggest. It is a sad commentary on the fatuity of the human mind to take note of the overwhelming preponderance of patents that answer no valuable purpose.

A large proportion of alleged inventions are by people utterly unacquainted with the subject, either technically or practically. A sailor would not be expected to satisfactorily plan an agricultural implement, yet he may not be legally restrained from the attempt. The patent office asks no questions concerning the inventor's business, knowledge, or training, as, indeed, it could not well do. Its only requirements are that the invention must be novel, in the sense of not having been publicly known for more than two years; useful, which it interprets quite differently from the usual accepted meaning, holding it to be synonymous with harmless; and the actual personal product of the petitioner. It claims and attempts no censorship on the practicability, worth, value, or usefulness of an invention and, in this respect, its actions may be considered wise, for the things regarded by many as foolish to-day, may be looked upon differently to-morrow. Therefore, no hope can be expected from this quarter in lessening the number of unwise and unprofitable patents; neither can the attorneys, or middlemen, be expected to turn away the dollars of prospective clients, although it is believed that most solicitors who value their reputation and are sufficiently competent will, if desired, point out, diplomatically perhaps, faults and fallacies, even at a loss to themselves.

Fully 90 per cent. of the total number of patents granted may be truly said to be unserviceable inventions. These may be subdivided roughly into three classes:

First, those which are suppressed by being bought up by competitive concerns,

who may prefer to make use of some inferior device, possibly, rather than exploit the later invention. This is the case with numerous inventions, especially relating to domestic and automatic machinery, made in large quantities, for which an expensive equipment for manufacturing may be necessary. Examples are to be found in typewriters, telephones, registers and similar mechanisms owned and controlled by large corporations. A knowledge of these inventions is usually sedulously kept from the general public. It may be said that as this class is but little known and has never been in use, the public has lost nothing, because it never had the invention in use. Be it remembered that it is a fundamental consideration that a patent to be valid must be new. Again, the inventor usually realizes something, financially, for his labor in these cases.

Second, those inventions which are simply and easily made, those in the nature of personal belongings which anyone can make with little fear from the law in so doing. These, unless in the hands of parties able and prepared by experience and equipment to manufacture and place on the market in large quantities and at low prices, might as well have never been conceived, so far as profits go, by the inventor. Examples of this class are found in mechanical instruments, calipers, gages, etc., the variety of which is almost as large as the number of individuals making them.

Of the third class, to which the great majority belong, are those inventions which are inherently useless from their lack of practicability, either in construction or use. Examples are to be found in every possible field of contrivance. If one successful invention is made it is sure to be followed by a crop of would-be rivals, each certain that his idea is superior. Yesterday it was cycles; to-day it is automobiles; to-morrow something else. There is no doubt but that the calling out of a large number of ideas on one subject is an excellent thing; that many of these ideas should be unserviceable is to be expected.

It is believed that we might profitably weed out most of these useless patents, and probably force some of the more meritorious into use, by following the practice of the majority of foreign countries in either obliging the working of a patent within a specified length of time, under penalty of forfeiture, or in imposing a system of annually increasing taxes. The new patent law of Austria does the latter, Germany does both, while Great Britain depends upon taxation to remove her useless inventions.

Another valuable custom which we might beneficially borrow is that of compulsory licenses, whereby if a patentee finds that he cannot work his invention without using a previous patent he may ask for a license to use the same, granting in turn to the owner of the prior patent a license to use his own invention. This should be whenever failure of the patentee to grant licenses can be shown; whenever the patent is not being worked; or the reasonable requirements of the public with respect to the invention cannot be supplied. These compulsory licenses may be ordered on such terms as may be just, according to the circumstances of the case, in fifteen foreign countries, including several which have lately revised their patent laws.

It would also seem that some steps should be taken to debar from soliciting such attorneys as persist in offering premiums, prizes and the like, and by blatant advertising seek to allure and entrap the unsophisticated into vain attempts at invention. The advice offered by many, to "Protect Your Ideas," would far more wisely and reasonably read "Perfect Your Inventions." It is a fallacy that is almost universally believed, that it is the course of wisdom to hurry an invention into the patent office. While this course may be wise in a few instances of a special nature, it is unwise with the majority of inventions, as the Government allows two full years of time in which to perfect the same. During this time an inventor may experiment and exploit as much as he likes, prove or disprove his theories, improve and add to his invention all that his experiments may disclose, and may even dispose of his prospective rights, without any disparagement to his patent privileges.

Should this course be taken, our patent office would not be so largely filled with what we have termed Unserviceable Inventions.

[We are in entire sympathy with the policy of taxing patents for the object described and for the benefit of inventors. It is of common occurrence for a successful inventor to find himself at the mercy of the owner of some old, but in itself useless, because impracticable, invention. The first inventor produced nothing of value, except as the second gave it value, and yet the second must pay the first for his own work! The system which keeps thousands of useless patents alive for no other purpose than to embarrass future inventors cannot be successfully defended. We have, however, no faith in the plan of requiring patents to be worked. Many alternative patents are taken out for the same purpose and by the same inventor, the intention being to make the best only, but to prevent others from making something nearly as good. This we regard as legitimate, and, in fact, many cases arise in which the inventor's interests can be protected in no other way. Again, the adoption of improvements often involves discarding devices which, while inferior, yet could not properly or safely be given to competitors, and to require the old devices to be made would discourage the adoption of new ones. Moreover, the requirement is a dead letter, so far as its real objects are concerned. This provision is in force in Canada, and we know of a case in which to meet it the inventor made *one* machine there and then stored it away. The patent had been worked (!) and anyone wanting the machine was at liberty to buy it, and in case of a sale a second one would have been made, so that the manufacture would have been "continuous," as required by law. In point of fact, the existence of the machine was not known to the public, and it was never sold, and certainly the law could hardly require the inventor to make it known by advertising it; and if it did, the advertising could easily be done on the same scale as the manufacture. The requirements of the law had been met, however, and the patent protected, and in his own good time the inventor sold it, and real manufacture under it was begun long after it would have expired if the patent had not been "worked." What is the use of being an inventor, if one has not enough ingenuity to get around a law like that? —Ed.]

Adjustable Multiple Spindle Driller.

We give herewith engravings of a multiple spindle drilling machine having eight spindles which may be adjusted to any required spacing within the limit of 9 feet 6 inches, from center to center of outside drills, and to a minimum of 40 inches, outside to outside, while any three spindles may be brought within 2⅝ inches, center to center, distance. In addition to this the drills have an adjustment of 2 inches forward and back.

The table on which the work rests is 10 feet 2 inches long. It has a vertical adjustment of 9 inches by means of the crank at the right and the screws which support it. The drill spindles run in sleeves, to which slotted arms are attached, these arms being bolted to a sliding cross rail attached to the uprights. The two bolts which hold each arm in place engage T-slots planed in the lower face of the cross rail, these T-slots permitting lateral adjustment while the slots in the arms permit the forward and back adjustment.

The feed is obtained by a rack and pinion movement applied to this cross rail at three points from a shaft which extends across the machine back of the cross rail, and which is rotated by the feed mechanism seen at the right of the machine; this mechanism being supplied with an automatic tripping device which disengages the feed at any desired point.

The thrust of the spindles is taken upon ball bearings, and they are driven by the universal joints seen from gear brackets above, which also are movable to any desired position upon the machine in order that excessive angle of the universal joints

may be avoided. This adjustment is provided for by deriving the motion from a splined shaft which permits the pinions to move along with the heads to any desired position. The cross rail is counterbalanced by the weights seen at the rear so that it is readily handled by the hand wheel at the right. Feeds of .005, .010, and .015 inch are provided, and the machine is capable of driving eight ⅞-inch drills in steel. It weighs complete 8,000 lbs., and is made by Foote, Burt & Co., Cleveland, O.

An Apprenticeship System in College Shops.*

BY PROF. O. P. HOOD.

The title of this paper names an expedient used to increase the usefulness and efficiency of a manual arts shop in a State agricultural and mechanical college.

I wish to give briefly the opinions which led me to the trial of an apprentice system, to note some results and, while expressing a belief that the plan I suggest is worthy of a trial in many places, to deny at once any universal application.

The ideals of the shop in question were near those of Worcester Polytechnic, but lacked the feature of commercial competition.

It was believed that shops without the life and movement of a real producing organization lack a most essential atmosphere, and a sacrifice of time and money is warranted in providing a variety of work, continuous running and a life not dependent upon the presence of students. It is usually agreed that a small commercial shop, because of its variety of work and a continual call for ingenuity, is a better place for training than the highly specialized manufacturing plant. A rigid adherence to a system of problems throughout a shop course, unaccompanied by any other constructive work, comes entirely too near furnishing the limited field of view of the manufacturing plant with its unending sameness of conditions and results. It was considered by no means desirable to dispense with the advantage of a carefully graded plan of work. While a systematized course formed the basis of all instruction, it was desired, whenever possible, to substitute for set problems some work of similar grade taken from a variety of ever-changing practical work. When such work was not available recourse was had to the stock problems, which were freely used early in the courses and seldom used later.

Such a plan requires a considerable variety of useful building. The expansion of a department and co-operation with other college interests will usually furnish sufficient opportunity.

Those who have tried to build machines in college shops have felt the need of some means of finishing those parts beyond the reach of student skill or requiring much repetition or labor at a time when that of students is not available. It is this need which furnishes one of the greatest objections to the policy of building things in such shops. If the need is met by departing from true ideals of instruction, the system becomes vicious, and the shop fails to furnish its greatest opportunity.

If machines are to be built, the problems furnished by each design should be graded. They should be given to students in a reasonable order as to instructive value and skill required. Such grading and sequence is not difficult during the early part of construction when there is a great variety to select from, but becomes serious as the work progresses. The easy and well-graded part of the work is soon complete, and one is left with portions unsuited to the skill or needs of the student.

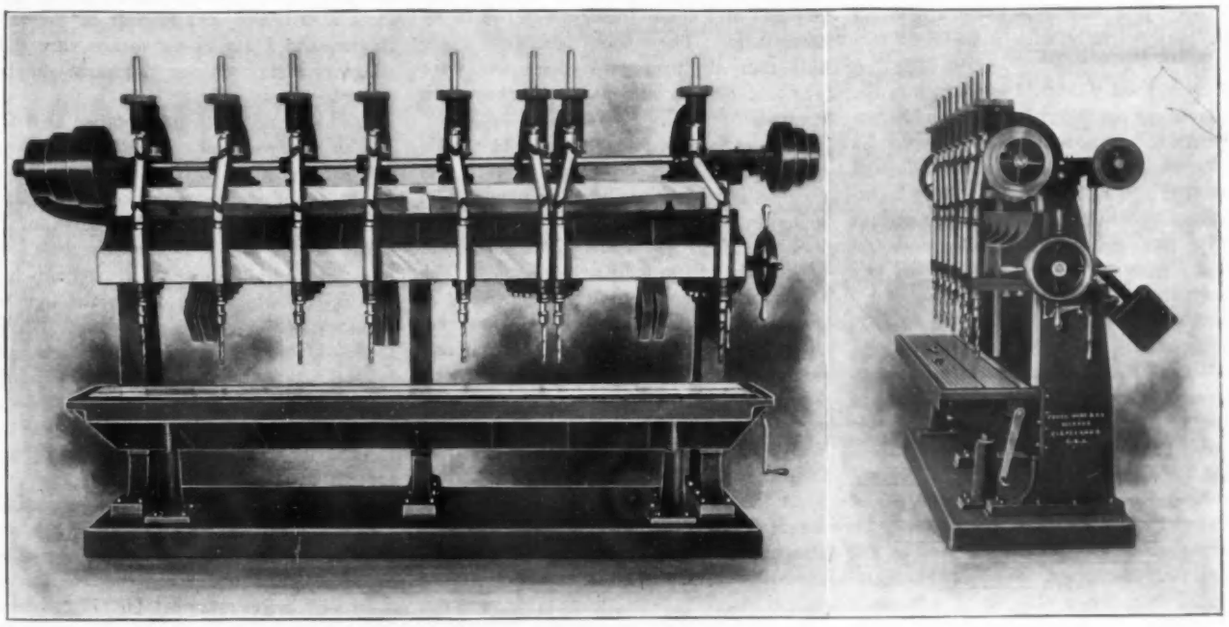
By supplying a considerable variety of construction, work of suitable grade may be found at any time. But with variety comes increased difficulty in bringing to a finish anything without help, at the right time, more skillful than that of students.

Again, a shop whose only life is that furnished by the presence of students and whose grade of work is that established by the average student ability, does not furnish the best conditions for growth.

Students lack the opportunity to measure themselves against those more skillful, and they obtain distorted opinions of their own ability. They lack opportunity for observing the numberless methods and manners of real shop life, the real capacities of tools, the handling of men, the attitude of employees, foremen and other officers. To meet these various difficulties would require a body of more skillful workers continuously employed, furthering work not dependent upon student habits, yet in entire sympathy with them.

College shops do not escape that mark of individuality common to all shops, when judged by the average grade of output, the design, finish, ingenuity and usefulness of its material product.

The average attainment is limited by the grade of student and the ideals presented. All students are affected by this average. Any plan which betters the grade of work for which students are even part-



ADJUSTABLE MULTIPLE-SPINDLE DRILLER.

* A paper read at the Columbus meeting of the Society for the Promotion of Engineering Education.

ly responsible, helps to supply a desirable condition. This, too, requires more skillful workers co-operating with students. The presence in the shop from year to year of some unfinished project begun by previous classes has a depressing influence on students. It seems very desirable when once a project is started to finish it, with certain movement, and in time to give those who share in its building a share in the pleasure of completion. The several needs so far enumerated are: First, a desirable variety of work to replace fixed problems (This will require some things which should not be expected of students); second, a shop life and movement not dependent entirely upon students; third, the presence of more skillful workers to raise the average grade of work in sight; and fourth, means whereby projects shall not become ancient monuments of incompleteness.

These needs show the desirability of employing men in the usual way, selected for their skill and for their ability to work harmoniously with a body of students.

This method I should prefer, but the usual college cannot afford it. The employment of one or two journeymen is hardly sufficient to establish the desired movement and atmosphere in a shop training from 100 to 300 students.

With paid help a State college would have difficulty in quietly disposing of any output, sold to reduce the expense.

Another line of thought helped to suggest the expedient tried. A manufacturer tries to run his plant full time in order to produce a maximum output. There are many college shops provided by the State which work on less than half time. An elegant equipment may lie idle a portion of each day or a portion of the year. The scheme of class hours or instructive periods may make it impossible to use the full capacity of the plant for its prime purpose. While "they also serve who only stand and wait," it seems a pity that these shops dedicated to instruction should for any cause find lack of constant usefulness. If the legitimate use of the shop requires that it lie idle for a time, or that its use in any other way is incompatible with its prime function in the engineering course, then there is excuse for this partial employment. I am not convinced of the necessity. There are many young men desiring such opportunities as the shop could afford, men unable to take a college course. These would be glad to give their labor in return for shop opportunities, and this labor can be made of sufficient service to warrant its use.

A call for apprentices was made through the college paper. Each apprentice was to be over eighteen years of age, acceptable to the superintendent, and was to work not less than thirty hours per week for forty continuous weeks. They were to work in the foundry, blacksmith shop and machine shop, as required, receive no compensation, and were subject to discharge at any time by the superintendent.

From many applicants, some of whom were college graduates, ten men were selected. Their age was nearer twenty than eighteen. Most of them had been college students at some time, but were unable or unwilling to continue. The average ability was about that of second-year college men.

At this time there were about 300 students in the various shops, but only thirty in the machine shop. The instructive periods were such that the metal shops had been employed but five afternoons in the week, leaving each morning and a full holiday unused. The apprentices were assigned to these periods. During the regular class hours apprentices were employed only as there was room; but it soon transpired that they were working most of the time. They were used in the foundry, making castings for regular work. Many changes and small repairs were made by their help. They soon possessed more skill than the average student, and were working on machine parts together with students.

It then became possible to build simple machines in short order and greatly increase the variety of work on hand. The general movement of the shop became a number of paces faster. Jobs that had been on hand too long were finished. The temptation to employ students on work of questionable instructive value was removed. Without doing violence to ideals such work could be given apprentices. The effect on student work was pronounced. There was a healthy rivalry with the apprentices, more perhaps than if journeymen had been employed.

At the end of the year, superintendent, foreman and instructors felt that the needs enumerated had been partly met by the apprentice system. The foreman preferred that the system be continued, for, while it required his time in one way, it reduced his difficulties in others and made the shop instruction more efficient.

The year's material output was of a better quality. Its cash value to the college paid for any outlay chargeable to the apprentices.

The system had not interfered in any way with the regular work of the shops, but had been a decided benefit directly and indirectly. The shops were employed the full day in training young men in the industrial arts. Most of the apprentices preferred to stay a second year.

Prof. J. D. Harper has had charge of the work since September, 1898, and in expressing unqualified approval of the system has extended it. Apprentices now receive some instruction in drawing.

There is a pressure of excellent material to select from. The better trained and more skillful are being used as student assistants.

I know of no other place devoted to instruction where young men are given so fully an opportunity to enter as apprentices a well-equipped shop as at the Kansas State Agricultural College. As the system seems to be of mutual benefit to the regular work, to the department financially, and to the apprentices employed, there is reason to believe the system may be useful elsewhere.

Michigan College of Mines.

Letters from Practical Men

What is a Broach?

Editor American Machinist:

By way of broaching a subject, what *is* a broach? We hear of the operation of broaching, of broaching-presses and of broaches, but when we reach the last named, one sort of an implement rises to the eye of the watchmaker's mind and quite a different sort to that of the machinist, and I am by no means sure that all machinists will see the same mental picture.

Rose said a broach is a toothed tool for cutting the walls of a hole, which is so delightfully general that he may have meant a mill, a reamer, a countersink or a file, or any one of half a dozen other tools. Moreover, he said that a *drift* is a tool that cuts the walls of a hole, but continues, "while it is driven through by hammer blows"; and according to the same authority a drift *pin* does not cut, being "a taper pin used by boiler-makers to drive through holes that do not come fair."

Even if we agree that Rose was often more voluminous than exact, we shall not find any solace by turning to other authorities. Webster asserts that a broach rotates or doesn't rotate; it cuts or it merely burnishes. According to the "Century," a broach never rotates, but is "pressed through irregular holes that cannot be dressed by revolving tools." But on the same authority, a drift "sometimes has grooves cut in spirals on the sides to give it cutting edges."

The "Standard" gives "reamer" as a synonym for broach, and clarifies matters by further stating that it is "a tool of steel with file-teeth for dressing holes where *rotating* tools cannot be worked." The "Standard's" drift is a tool "sometimes with cutting edges for enlarging and smoothing the edges of a hole."

According to Knight, a broach is "a tool of prismatic form, and whose edges are used for *reaming* out holes." But again, "some broaches have file-teeth to enable them to cut with a thrust without rotation." He adds, "These are more properly drifts."

Appleton's broach is an elaborate tool for mortising metals, and is driven by a press. A drift, on the same authority, is

a conical pin, or it may be "a toothed or *cutting* drift."

In regard to reamers, broaches and drifts, "where are we at?" Does a broach rotate, or doesn't it? Does a drift cut, or does it merely stretch? If a broach does rotate, where shall we draw the line between it and a reamer?

There seems to be but one clear line which has some, but not a preponderance of, authority. It is this: A reamer rotates and cuts, to enlarge holes circular in cross section; a broach *cuts* polygonal holes by being pressed or driven through them without rotation, and a drift merely *stretches* or aligns holes of any cross section, without removing any metal.

This may seem a matter of small importance to many; a broach by any other name will work as well, but when the task arises of placing patents for these tools in classes where they will be found by the ever-increasing army of inventors and searchers of records, it behooves them to have a *name* that they may be given a local habitation, and a name which does not mean one thing to one man and something else to another.

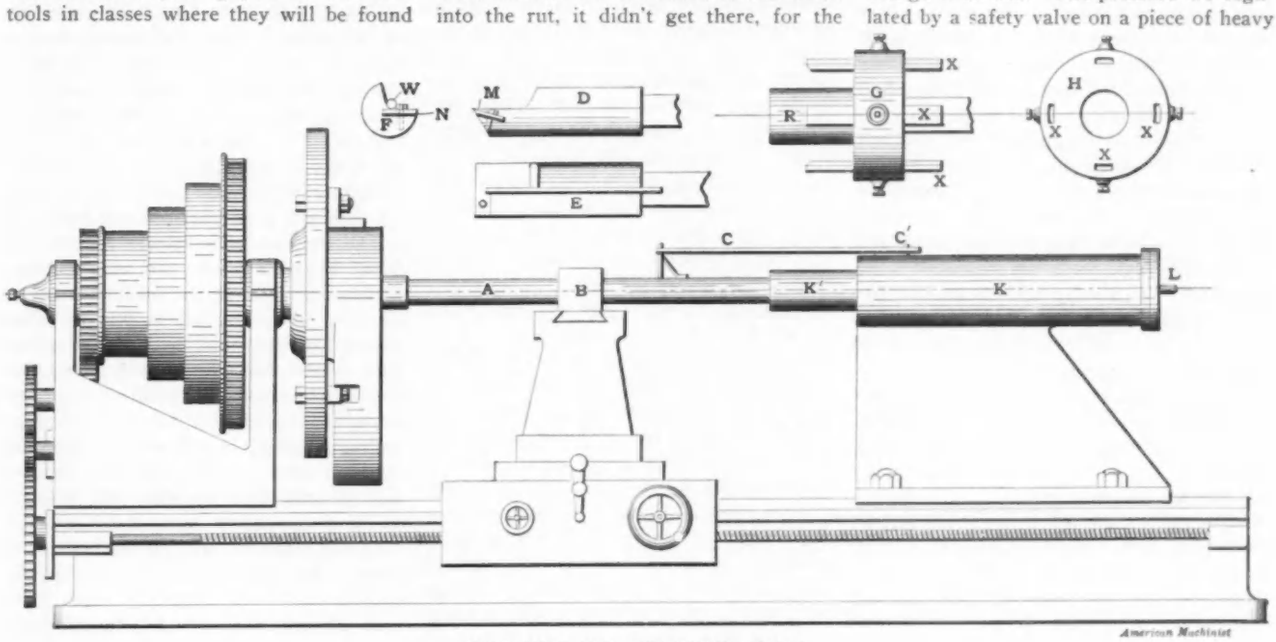
Can the trade settle upon the line suggested without doing violence to its traditions and trade catalogs? NOVICE.

Boring Cranks With Hydraulic Feed.

Editor American Machinist:

There are many valuable ideas lost to manufacturers by the lack of attention to employees who have new ideas that would improve the product or the method of turning it out. I have often heard the expression: "Well, I will keep it to myself, for it will not do any good to show it to the company." Of course this does not mean all companies, for there are many that offer inducements to their men for improvements and suggestions. Even though they are not all accepted, it offers inducement for further investigation. The inventive genius must come out, and will bear fruit somewhere and at some time. An illustration of this came to my notice a few years ago along the docks in New York city. An elderly woman was gathering firewood, and among other pieces she had found one about 4 feet long. She seemed troubled about how she should break it, so that it would lie in her apron. Did she sit down and order a sawmill, with engine and boiler, engineer and fireman and all that? Not much. She just walked along the street until she came to a rut where cart wheels ran, and she waited and I waited, and soon there came along a heavy coal cart. No, she didn't ask the driver to get down and borrow an ax and cut it for her; but just as the wheel of the cart was about to run down into the rut, it didn't get there, for the very good reason that the old lady's stick was there first. That old lady and her stick did me more good than all the school marms, with all their sticks, that I ever ran up against. Well, so it goes, and our Patent Office is the result of all this inventive genius, for man expects a return for his labor.

Just along this line, we have a job. We at one time had a good many wrought-iron cranks to fit up, and the hardest part of it was to get the first hole through. We had a very old lathe in the shop that was built for business, but not just this kind of business. It had lots of iron in its make-up, and consequently lots of backbone. As I recall it now, it had only three steps to the cone, but they were made to take a wide belt. This seemed the machine to finish the cranks in, but there was one thing lacking. The tail spindle screw was not fit to force a large drill through the solid iron and make time. Well, we found a way out, by designing a cylinder with a piston and a heavy rod, as shown on the sketch. This was cast to a tail block just high enough to bring it in line with the head stock. Then we fitted up a large drill, 3 or 4 inches in diameter, as shown at *D*, *E* and *F*. The steel cutter is shown at *M* and *N*, with a water tube at *W*. This drill head we keyed fast to a square bar *a*, held firmly in a guide B, which we fitted to the tool-post rest of the lathe. On this bar *A* we fastened a small bracket for the small wire rope *C* that passed around the pulley *C'*, held in place by a stud on the top of the cylinder. As soon as the water pressure was shut off from the back end of the piston, a weight on this wire rope would draw the drill back, for relieving the chips. A three-way cock at *L* would admit the water to the cylinder, or discharge it at will. The pressure we regulated by a safety valve on a piece of heavy pipe for a tank. Another large piece of pipe served as an air chamber to prevent an unsteady feed for the drill by the action of the plunger pump that supplied the water for the cylinder. As the tail-stock fastening for the lathe, as it was originally, was not strong enough to hold for this new method, we put in reamed bolts through the new tail-stock base and into the top of the lathe bed.



HYDRAULIC FEED FOR BORING TOOLS.

In shops where a large amount of this class of work is finished a lathe of this style, built with special means for handling work, would be a very effective tool—very much better in many ways than a vertical drilling machine. One advantage is that the stream of water passing through the tube W washes all grit away from the cutting edge of the cutter, which would not be the case with a vertical bar. Then the chips will fall away and work out and not clog the drill.

Our next operation, after the drill *E* has been put through, is to replace it with the

boring head *G*. This has a guide *R* that fits the hole in the crank and steadies the head so that the cutter *X X* will stand up to the work and not spring to one side or the other. These cutters will remove a block of metal from 12 to 18 inches diameter, and save a great many cuts through the bore that would have to be taken if the stock was bored out with cutters in a tool bar or boring head in the usual way. A set of these cutters *X X* will last a long time when properly used. They should be made about 3 to 4 inches wide and about ⅝ inch thick, and never project from the head any farther than the depth they are to cut. The cutters should be well fitted, so that they will not get loose when in service.

There are a great many uses a lathe of this kind may be put to, as, for boring couplings, crank disks, etc., where a large amount of stock is to be removed, and it is the improved methods and improved tools in the machine business that are telling at present and will tell in the future. A number of years ago I was employed with a company that had been in business through two generations. They had a great many tools that were a long time out of date. A change in the head of the shops came about, and the new head was of an up-to-date make-up. He saw what the work was costing and decided to try what could be done in the way of, first, an improved lathe. Of course this was a small beginning, and it was hard to get it; but after making some strong promises he got it. It was surprising to see what a difference there was in the quantity and quality of the work. He said nothing for a time, but the boss got on to the matter and began to get interested. He would come around and watch the lathe and ask questions as to how it was that there should be such an increase. This was pie for the new man, and he just took advantage of it for fair. The next turn of affairs was the matter of reducing the cost of a lot of small pins used in the construction of their machines. He said to the boss, one day: "I am sure you can save 75 per cent. on that job if you will put in a certain build of monitor." Well, the boss had found that the new man's statement concerning the lathe was all straight, and the monitor was ordered. Of course there was no grass growing under the new man's feet until the machine was set up and running. Did it pay? Well, the best answer to that question is that inside of three years there was a department made up and eight monitors of different makes were running therein. Now if the new man had said just what he wanted to, he would have told the boss to sell every old tool in the place and put in the latest improvements. Of course he expected the boss would drop dead if he made such a proposition, and as he was anxious to remodel the shop, he wedged in one tool at a time and got there. The time saved on these new machines often amounted to the full amount in the statement the new man had made, and in some cases reached 90 per cent. The result was that the boss often came into the shop and suggested that some other tools might be put in to replace old ones. It is very hard sometimes to get a company to see this, but it is a fact, notwithstanding that it does not pay to use old tools, unless it may be in shops where jobbing is done to a considerable extent, and while there may not always be use for monitors and milling machines, it will pay to use up-to-date lathes and planers. H. S. Brown.

The Poor Old Tools.

Editor American Machinist:

If old age is desirable, it is not an unmixed blessing to sheep and pigs and chickens and the other edible creatures to be acquainted with man, for he never permits them to die of old age, and it is, I believe, to this day rather problematic as to the age limit of the hog. Wild animals, however, seem to have little better chance of longevity, for there is no one to provide food or protect them when they became infirm, and, so far as I know, of all living things men and women and some cats and dogs are all that have much chance of dying of old age.

It is about the same way with machinery of various kinds. The engines of Hudson River steamboats used to be extremely tenacious of life, and many of them did good service in several hulls in succession, but of late years not only the individuals of the race but the entire genus seem to be consigned to extinction. It is in the natural order of things that machine tools also should not last forever. They should, generally speaking, not be permitted to either wear out or to rust out, but should be swept smoothly onward to oblivion and take the final plunge with their normal abilities little abated.

I have been provoked into thinking along this line by what is just now happening to one of the most venerable and eminently respectable machine tools within the wide circle of my acquaintance. The tool referred to is an 8-foot swing, triple-geared lathe, built at the Neptune Works, in New York city, in the late forties or the earliest fifties, and when built one of the best lathes in existence. The firm by whom and for whom the lathe was built having gone out of existence, as such concerns have, or had, the deplorable habit of doing, the lathe was later installed in a most responsible position as the largest tool of its class in the shop of Starbuck Brothers, at Troy, N. Y., which for a score or more of years was the largest shop in the State outside of New York city. The business of the firm was the building of stationary and marine engines and general machine work, and the lathe did excellent service right along. Of course more and more was attempted with it as time went on. Blocks were first provided to raise head-stock and tail-stock to swing 10 feet, and then additional blocks to make it take 12 feet, and with this swing quite a big slice had to be cut out of the wall at the back of the lathe.

Now that this lathe is nearly, or quite, a half-century old, still bigger things are demanded of it. The lathe is to be converted into a gap lathe for turning pulleys and flywheels up to 20 feet in diameter. The lathe, as it is proposed to regenerate it, will have been built partly by the machinist and partly by the bricklayer. It is to be hoped that they will not get to quarreling over the distribution of the honors.

About 6 feet of the lathe shears are to be cut out between head-stock and tail-stock for a gap, and then the whole thing is to be raised and brought forward upon sustantial piers of masonry. On each side of the head-stock and tail-stock there are piers of sufficient hight to carry T-slotted castings running at right angles to the lathe axis, and on these castings slide rests will be bolted, one before and one behind the lathe, to carry tools. The slides will have screws for their entire length, about 6½ feet, and a ratchet feed will be used.

The pulleys to be turned will first be bored by other means and mounted on a mandrel as near to the face plate end as possible. The original face plate, which is still on the lathe, with large internal gear at the back for driving, overhangs the end of the lathe spindle for an inch or more, the end of the spindle being 8 inches or more in diameter. This overhanging part is to be carefully rebored, and the end of the mandrel will be turned to fit it, instead of using the live center. Driving brackets will be bolted to the face plate to drive against the several arms.

It will not be long now before the lathe will be in operation in its enlarged capacity. It must be perfectly evident that the lathe will not possibly be able to turn a 20-foot pulley in anything near the time that it could be done in a modern boring-mill. With its insufficient power and various inconveniences, it will do well if it does not take more than four times as long as the boring mill, and some mechanical wiseacres will be standing around and remarking how little their grandfathers knew about building machine tools. No tools should be allowed to grow so old in the shop that they can be imposed upon and disgraced. If the proprietors lose money by the game, that is their lookout; but I have some feeling for the poor old tools. I find myself generally rejoicing when I hear of the burning of an old machine shop, for I know that usually it is the timely cremation of some venerable lathes and planers that have done their share of good work, according to the standards of their times.

Tecumseh Swift.

Loopholes in the Premium Plan.

Editor American Machinist:

There is considerable discussion going on in some of the trade papers at the present time in regard to the various methods of running a machine shop to the best advantage, and particularly as to the best system of increasing production. The two most prominent plans at the present time appear to be job work and the premium plan. I am, at the present time, foreman in a large machine shop, where both systems have been in vogue, and the job work has given way entirely to the premium plan. I have had an opportunity for the last two years to give the premium system a thorough study, as it comes under my direct supervision, and I have not as yet decided whether or not it is an unmixed blessing. All the articles that I have seen in the "American Machinist" are very much in favor of it, and while I am not opposed to it, still I would like to point out a few of its possible dangers. The superintendent who introduced it into the shop declared that its workings were a revelation to him. And his innocence was a revelation to the men. He used to figure a job in this manner: He would take the time that went in a job, and the next time a similar job came along he would give the man about to do it the first man's actual time, as taken from the time cards, and add a little extra time to encourage him. A notice was posted in the shop giving the rate per hour each man would receive for the time he saved, and guaranteeing there would be no cut in the time, unless there was an improvement either in the tools or in the method of doing the work. The first jobs that came out were snaps. The men worked no harder than they would on day work, and still they received their little premiums with smiling faces. Our worthy superintendent labored under the impression that so many worthy men have labored under, that a time card shows the actual cost of a job. But he discovered that this was a mistake, or he should have discovered it by this time. Men on day work will charge time on a job that never really belongs on it. If a machine breaks down and they have to repair it, if they have to wait for their foreman, or if they get two or three odd jobs to do, the time will all be slapped in on the one time card. But, someone says, the foreman should look out for that. But he, poor man, if he has a large gang of men to look after, and has to snatch five or ten minutes to look over time cards when he is wanted in some other part of the shop, cannot be expected to notice all these little discrepancies.

But to return to our superintendent: As I have said, he declared the system was a revelation to him, and one of the trade papers published a list, a sort of "before and after using" affair, showing the tremendous saving in cost of production produced by the premium plan. And I will have to admit if the actual shortening of time was even half of what the table showed, the premium system had worked a miracle. But here is where the weakness of the thing comes in. Men working on a job upon which the time had not been set, or upon any new job that came along, held back in the expectation that at some time in the near future the piece would be put on premium, and the more time shoved in on the job the more premium would be earned when it came out. The man who had been doing an honest day's work got no more time that was actually necessary to do the job in, and had to guarantee his work, as he would not be paid for any job which would not pass inspection, and if he worked overtime he received only single time for his labor instead of time and one-quarter, which he would receive if he were on day work. In other words, the man whose premium is figured low guarantees his job, works overtime without extra compensation, and if he raises his voice in gentle protest he is shown the notice on the wall and told that is a part of his contract. The dishonest man, on the other hand, reaps a harvest out of the premiums, and with but little extra exertion. It has been my experience that where the job work or the premium system is in vogue the cost of day work is nearly doubled, as the man who is working day work will never make an effort to work any faster than is absolutely necessary to hold his job. And if work is done in, say, 10 hours the first time it comes out, and is then put on premium and done in 5 hours, the man who says the premium plan is responsible for the saving of the 5 hours is, to use a slang expression, talking through his hat. The chances are that if there was no premium in the shop the job would have been done in eight hours the first time, and the second time it would have been done a couple of hours quicker anyway, which would reduce, if these estimates are correct, the actual saving by the premium plan to about one hour, and it strikes me sometimes that the hour saved is of doubtful utility. And I have known of jobs where the man got an extra good price and actually worked slower than he would day work and received the premium for practically no increase in production. However, I am not an opponent of the premium plan, but, on the contrary, I think if properly administered, the time being estimated by competent mechanics, and an absolute guarantee given that there will be no cut in prices, that the system will be beneficial. The principal thing is to estimate the time, get it neither too high nor too low, and abolish day work altogether.

I. F. McCarthy.

[Our correspondent's letter undoubtedly points out some things that must receive more attention than they do in some shops if the premium plan is to be successful. The tendency on the part of the men to go slow on new work in order to set records which are favorable to themselves undoubtedly exists, but in this respect the difficulty with the premium plan is less than with piece work. This was discussed at length in our issue of March 23, where it was shown that with piece work the workman gets the full benefit of such a mistake in the base time allowed, while under the premium system he gets but a portion of it. So far as the comparison of records given in the article of the March 9 issue is concerned, the figures given for the day work contract showed the actual time consumed—not the time limit, which was in some cases in excess of this. Moreover, the day work figures were, we believe from work most or all of which was done before the adoption of the premium plan. We wish it to be understood that we have no desire to encourage the indiscriminate adoption of the premium plan. Except in competent hands and in well organized shops difficulties like those pointed out by our correspondent, and others which he has not named, will certainly appear. It is not a system that will run itself, but, to quote from the original article of our March 9 issue, "it puts a sharper test on the capacity of the management than it does on that of the workmen, and this fact will determine the limits of its application."—Ed.]

A Practical Fireproof Floor—"Made in Germany."

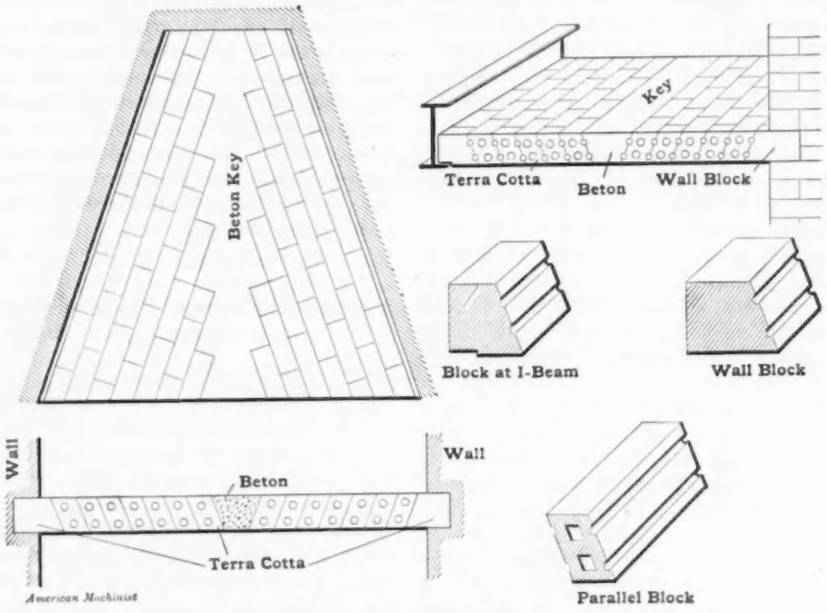
Editor American Machinist:

A floor which I see going up a good deal in Dresden, for apartment buildings and stores, strikes me as being particularly well adapted for machine shops which have more than one story. It can be laid between iron beams or between a beam and a wall, and is especially adapted for places where the beams are not parallel. The principal peculiarity lies in the keystone. This keystone is no stone at all, and that is the beauty of the thing. The blocks which compose the "flat arch"—as we miscall such a filling—are of the usual type of terra cotta, with lengthwise passages, formed in an "auger" brick machine, and, with the exception of the side blocks, which lie on the flange of the I-beam or in gains in the wall, are all alike in size, shape and angle, as shown in the sketches. When they are all laid in and grout is poured between them, so as to lock them together, the intervening space, where the keystone ought to come, is filled in with good beton, well rammed, and when this has "set" firm the wooden false flooring on which, in lieu of the centering usual when real arches are built up, the blocks were laid is removed. No iron strapping is used for wide spans, and no blocks need to be hacked to size, and any

chump can lay this floor as well as a skilled mason.

I give here the prices at Dresden, cost of labor, per square meter, for the ordinary wooden joist floor and this new kind, or variety of an old kind:

JOIST FLOOR.*	Marks.
40.25 running meters joist, 26x22 cm.	96.
40.25 running meters joist, to lay and bind	14.09
26.77 sq. m. false ceiling on boards, with nailed laths 24 mm. thick, incl. work	32.12
26.77 sq. m. mortising of beams from 10x10 cm. stuff for the nailing on of the floor	14.72
26.77 sq. m. ceiling plaster 20 mm. thick, in place	26.77
26.77 sq. m. reed coat for plastering, incl. material	24.09
	207.79
or per square meter	7.77
or per square yard	$1.55



SOME GERMAN FLOORING.

TERRA COTTA FLOOR.*	Marks.
11.50 running meters I-beams, in place	73.02
26.77 sq. m. floor in place	93.69
26.77 sq. m. ceiling plastering, incl. all materials	12.04
26.77 sq. m filling	6.09
26.77 floor boards, in place	15.52
	203.36
or per square meter	7.48
or per square yard	$1.49

As regards the strength of this floor, it leaves little to be desired, and for upper floors of machine shops it is simply a question of choice of I-beams.

ROBERT GRIMSHAW.

Dresden, Germany.

*Room 5.25 x 5.10 meters = 26.77 sq. m.

Booming Liquid Air.

Editor American Machinist:

Believing that you and the readers of your valuable paper are interested in every new and startling advance in the engineering field, I enclose with this a circular setting forth one of the *most startling* schemes which I have recently seen. At least there has been nothing in Boston to equal it since the Rev. Mr. Jernergan left for a sojourn "across the pond."

I visited the office of the "Liquid Air, Power & Automobile Company" early this week, and was informed that the models of their "power transmitter" would "probably" be in that afternoon, and the next day surely. To-day, five days later, they are still "expected this afternoon."

On the occasion of my first visit, a set of patent drawings, or blueprints from the originals, was produced for my inspection, and the promoter proceeded to elucidate the method of "gaining power" by means of this wonderful "power transmitter in which invention alone there is a fortune." This device, so far as I can judge from the drawings (I have had fifteen years' experience making drawings), consists of two very crude expansion pulleys, connected by a leather belt. These pulleys apparently consist of radial pins set in the hubs and carrying cross pins, i. e., parallel with the axis, and which may be moved in or out upon the radial pins by means of a sort of toggle-joint device operated by gearing, so that one pulley contracts as the other expands. This appears to be the chief talking point of the company.

Their system of utilizing liquid air for propulsion of automobiles, as it exists on paper, is about as follows:

An insulated storage tank is connected by a pipe "no larger than a pencil" to a small pump, which draws off the desired amount of liquid air and forces it into a small chamber in one end of the "superheater." Seven (magic number) coils of pipe connect this chamber with a second, and about these coils are wrapped wires connected to a dynamo, which the promoter says is "no larger than a watch," and which is driven from the motor itself. This dynamo furnishes sufficient current to "heat the air up to 200 pounds pressure" by the time it has passed through the coils into the second chamber.

From the second chamber lead two pipes, one to the "engine" and the other to the governor. The promoter says they "call it an engine because that is just what it is, a rotary engine with the *ordinary* valves and *things* and not a motor." The "governor" is a "marvel," and is best understood with the aid of a sketch which I enclose. The spring plunger *a* is enclosed in a cylinder which communicates by means of the pipe mentioned above with the "superheater." When the pressure exceeds the desired 200 pounds, the piston is depressed, moving the rod *b*, thus shifting the belt along the cone pulley, which, by the way, the gentleman I interviewed called indiscriminately a "T" or "V-shaped pulley." As is apparent from the sketch, this will change the speed of the pump, and hence the amount of air supplied. Someone may wish to know what becomes of the slack of the belt, to which I can only reply, in the slang of the day, "Search me."

The present company is apparently prospering, as they have moved their office from the fourth floor down to the second, and have a brand new carpet on the floor of the "inner court."

The officers of the company I know nothing about, beyond the fact that the president has been in the patent-soliciting business here in Boston for years, and the inventor, Mr. Code, was connected, during the early summer, with the United States Liquid Air & Power Company, as I remember the name, and of which nothing has been heard recently.

HOWARD L. COBURN.

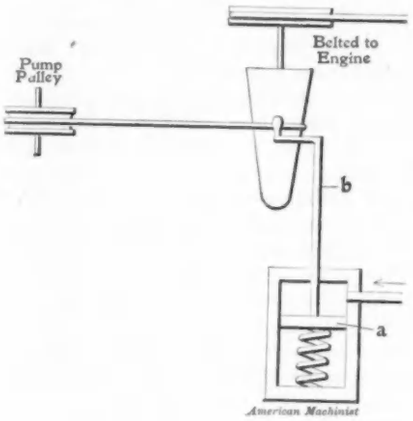
[The following extracts from the circulars of the company referred to require no comment or explanation. Our readers are entirely able to appreciate them and to determine the consideration that should be accorded them.—Ed.]

AND THE LAST SHALL BE FIRST.

Steam and electricity, giants both as they are, have had their day. As motive powers they are on the eve of eclipse; the latest and greatest discovery of all, liquid air, is the world's mightiest marvel, and even in its infancy has demonstrated its ability to outdo both. Steam and electricity, each in its turn, created a revolution of advancement in civilization, comfort and convenience to mankind, and have contributed enormous wealth to those who developed them; but their

fields were and are limited when compared with the transcendent possibilities of liquid air, whose power is not only on the earth but above it and beneath the sea as well. Much has been written of this newly discovered force, but it has thus far been considered principally as an agent for refrigerating purposes, or as providing a healthful atmosphere for hospitals and sick rooms. True enough, it was available for little else until the proper harness was discovered for it to work in; but now, with the inventions of George Code, Hans Knudsen and Milton Chase to control and apply it as a motive power, its possibilities of usefulness and profit admit no bounds less than those of the firmament above.

For all purposes of manufacture it means a saving in plant, in running expenses, and in wear and tear of buildings, through the economy of its production, the lightness of its equipment and



superior effectiveness of its work. For all purposes of transportation, by the same qualities it is unequalled, unrivalled and unapproachable—and it makes possible not only better transportation upon the land and the surface of the water, but opens up to man's use and enjoyment the hitherto unattainable aerial and submarine lanes.

As an instrument of war, offensive or defensive, it will surpass powder, dynamite, gun cotton, even the dreaded "earthquakes" hurled upon the Spaniards at Santiago by the famed Vesuvius, and in addition will facilitate the handling of the heaviest guns of fort and battleship.

Such, in brief is the real field of this new and greatest force ever wrested from nature—its application as power to move the wheels of commerce and the engines of war.

. . . . . .

From Faraday's first success in liquefying a gas to the harnessing of liquid air as the universal motive power is a long step, but no greater than the progress from Watt's tea-kettle to the magnificent steam engines of the present, or from Franklin's kite and key to Morse's telegraph, Edison's light and Bell's telephone. The same time and labor and thought of scientific men have again fructified into a magnificent gift to mankind in the production of liquid air; and the time, labor and thought of inventors Code, Knudsen and Chase have not only harnessed the gift to the commercial and practical uses of everyday life, but even added to its capabilities.

Not only have these men devised the means of controlling the power of liquid air to the use of man, but through their ingenuity have been devised the means of more than doubling its effectiveness, for they have made possible the production of 5 horse-power from 2, without additional cost.

Bolting Brackets to Brickwork.

Editor American Machinist:

The following method for fastening brackets, etc., to brickwork has been found simple and reliable.

A hole of suitable size is drilled in the wall, into which a piece of lead pipe is then inserted. The lag screw, well oiled, is screwed into the pipe, which expands and is compressed into the inequalities of the hole, thus making a secure fastening.

Below is a table of dimensions of piping and drills for lag screws, from ⅜ to ⅞ inch diameter:

Lag Screw.	Lead Pipe.	Drill.
⅜″	¼″ x 11 oz.	$\frac{9}{16}$″
½″	⅜″ x 2 lbs.	⅞″
⅝″	½ x 3 "	1″
¾″	½ x 3 "	1 $\frac{1}{16}$″
⅞″	⅝ x 4 "	1 ¼″

WM. SANGSTER.

Jamaica Plain, Mass.

The Way to Pay Off.

Editor American Machinist:

I wonder if any of your readers with a memory which reaches 'way back will recognize this:

"About the middle of Saturday afternoon 'Uncle Jake' would start from the office on his round, gold watch in hand, and once every thirty seconds sharp a workman, at word from 'Uncle Jake,' would lay down his tools and take lively steps for the office, until every one in the works in succession got a cheerful hint and made a prompt response.

" 'Uncle Jake's' word, as he came to me, was 'Gogetyrpaybub.' *I went.* The paymaster was busy, but not hurried, and I got my pay promptly, and went smiling back to my work. No friction there, nor confusion.

"Theoretically, the aggregate time taken weekly by all hands to go to the office for their pay in work hours was equivalent to the loss to the company of half a day's work of one man, which might have been saved if they had compelled their men to stand in a row out in the weather after work hours till they could be paid one by one. And 'Uncle Jake,' the superintendent, spent two hours of his precious time to make the round.

"But, on the other hand, the method brought the superintendent, once a week, into personal contact with every employee —mechanic, laborer or boy—and this established a friendly link between the office and the workrooms which more than compensated for the precious loss—*if there was any loss.*" J. H. Dow.

A Kink in Drawing Screw Threads.

Editor American Machinist:

Some time ago I read about a draftsman who used cardboard templates representing flat-head bolts, full size, the notches for the threads being sharply cut, so that they could be followed (first the lines from right to left, and then those from left to right) by a pencil point. He had a number of these of several sizes. I must confess that I have never relished the task of cutting cardboard templates; they are too easily injured, both in the cutting, in the first place, and in their subsequent use. Thin wood veneer, sheet brass or zinc take more time in preparation, but make a much more lasting job.

So far as the threads on the bolts are concerned, one can easily get them already cut out in a more enduring form than brass or zinc; namely, sheet steel in the form of a screw pitch gage. The rivets have to be taken out if it is desired to lay the strips down flat on the drawing board. To follow around the teeth and get respectable results is not the handiest task, even with a well-sharpened pencil, and when I want to lay out something in the thread line with the template, I simply press the points lightly on the paper along the line I wish to divide, and do the rest with the triangles. As a rule, the points are sharp enough to make a good impression; but a rub or two of a file is needed to thin the steel strips at the tooth points in order that the marks may be more nearly dots than lines. These screw pitch gages seem to be made very closely to size, as well as I can determine with glass and scale, and I daresay the strips can be used for other purposes, requiring division of any line into parts, than the threaded surface of screws. ROBERT. I. CLEGG.

Improved Index Table for Milling Machines.

Many users of the universal milling machine never attempt to master the principle of the indexing, but simply follow the tables supplied by the makers, and as these mention only one circle of holes for any given division, plates are often

changed when, if the indexing were understood, this would be unnecessary, because often the plate already on the machine will answer for the required division quite as well as the one called for by the table.

For instance, if three divisions are wanted and there are forty teeth in the worm wheel (as there usually are), then the index pin must be turned 40 times ⅓ of a turn, or $\frac{40}{3}$, or 13⅓ turns. It is clear that any circle will answer for the whole turns, but that for the ⅓ turn we must have a circle divisible by 3. On the B. & S. machine, and others using the same index system, there are six circles which are divisible by 3, and any one of them can be used for the division, one as well as another. These circles are 39, 33, 27, 21, 18 and 15. The index table gives 39 only, and the man who is a slave to the table will take off the 15 plate, for instance, when it is on the machine, and he wants to cut three flutes or six flutes. It is the same with a 15-tooth pinion, for instance. Here the movement of pin required is 40 times $\frac{1}{15}$ of a turn, or $\frac{40}{15}$, or $2\frac{10}{15}$, or 2⅔, and it is clear that the same circles will answer.

We recommend familiarizing one's self with the principle of the thing, and when this has once been thoroughly done it will be little or no bother to select any available circle and to perceive at a glance whether or not a plate already on the machine will answer the purpose.

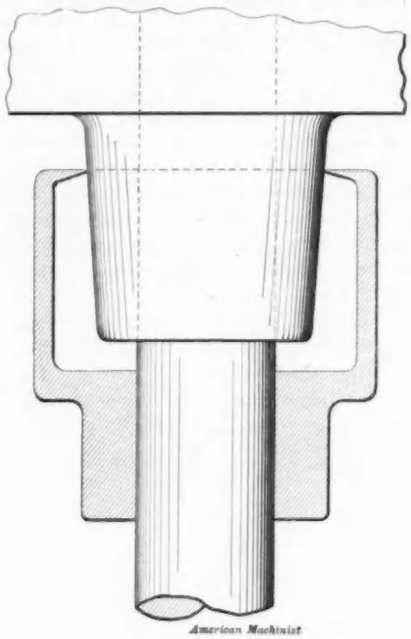
But some will not take the trouble to do this, and for such men Mr. E. Gauthier, of Woonsocket, R. I., has devised and sends us a copy of the index table printed below, which, however, we have modified a little, with a view to adding to its convenience:

Division.	Circle.	Turns.	Holes.
2	any	20	
3	39	13	13
	33	13	11
	27	13	9
	21	13	7
	18	13	6
	15	13	5
4	any	10	
5	any	8	
6	39	6	26
	33	6	22
	27	6	18
	21	6	14
	18	6	12
	15	6	10
7	49	5	35
	21	5	15
8	any	5	
9	27	4	12
	18	4	8
10	any	4	
11	33	3	21
12	39	3	13
	33	3	11
	29	3	9
	21	3	7
	18	3	6
12	15	3	5
13	39	3	3
14	49	2	42
	21	2	18
15	39	2	26
	33	2	22
	27	2	18
	21	2	14
	18	2	12
	15	2	10
16	20	2	10
	18	2	9
	16	2	8
17	17	2	6
18	27	2	6
	18	2	4
19	19	2	2
20	any	2	
21	21	1	19
22	33	1	27
23	23	1	17
24	39	1	26
	33	1	22
	27	1	18
	21	1	14
	18	1	12
	15	1	10
25	20	1	12
26	39	1	21
27	27	1	13
28	49	1	21
	21	1	9
29	29	1	11
30	39	1	13
	33	1	11
	27	1	9
	21	1	7
	18	1	6
	15	1	5
31	31	1	9
32	20	1	5
	16	1	4
33	33	1	7
34	17	1	3
35	49	1	7
	21	1	3
36	27	1	3
	18	1	2
37	37	1	3
38	19	1	1
39	39	1	1
40	any	1	
Degrees.			
1	18		2

IMPROVED INDEX TABLE.

Oiling a Vertical Shaft Bearing.

Mr. James Brady, in speaking of the troubles which sometimes arise from the difficulty of thoroughly oiling the bearing of a vertical shaft, drew a sketch, from which the accompanying engraving has been made, showing a plan adopted by him some years ago for getting over what appeared at the time to be rather a serious difficulty. A vertical shaft running at considerable speed refused to run cool unless a sufficient amount of oil was put on it to run down over the shaft and those parts of the machine below the bearing, making rather an ugly mess of it. He therefore attached to the shaft the oil cup shown in section. This was fitted tightly to the shaft below the bearing and extended up over the bearing for a considerable distance. It was kept filled with oil,



OILING DEVICE FOR VERTICAL SHAFT.

so that the lower part of the bearing ran in a bath of oil which could not escape, and there was no further difficulty. The oil exhibited a tendency to rise to the top of the bearing above the level of the oil in the cup.

One of the surest and most enduring of businesses would seem to be that of the shipbuilder, and chiefly that he is sure of so large a trade in replacing vessels lost or destroyed, or superseded by modern developments. In the last quarter of 1898 the rate of loss of ships for twelve maritime countries was 1,000,000 tons a year, or nearly one-half of the new tonnage turned out in the same year. If machine tools had such a habit of going out of existence it would not be an unmitigated misfortune to the trade. There are many tools still running which would be better at the bottom of the sea.

Second Annual Meeting of the American Section of the International Association for Testing Materials.

The meeting was called to order at 10.30, 11th inst., by President Mansfield Merriman, of Lehigh University, in the hall of the Engineers' Society of Western Pennsylvania, Pittsburgh, Pa., thirty members and a number of guests being present. About forty-five members reported before the close of the session.

After presentation of the secretary's and treasurer's reports the member of the International Council, Mr. Gus C. Henning, member council A. S. M. E., presented his report, detailing what had been done abroad, and letters relating to the invitation to and participation in the World's Fair Congress to be held at Paris in 1900. As the substance thereof is of interest to all engineering associations, an abstract is here given:

After the International Association had been twice invited on behalf of the French Government to hold its congress at Paris in 1900, and such invitation had been accepted definitely at the Stockholm congress, in 1897, it developed at a council meeting held in Paris in May last that such invitation was to be ignored. The original statutes governing the engineering congress of 1900, issued by the French Government and transmitted to the councilmen months previously, stated that such organizations which were in the habit of holding international congresses should also arrange their own congress for Paris. Without any reason or explanation, or any previous announcement to that effect, the council at its May meeting in Paris was informed that the proposed congress could not be held in 1900, and it was clearly stated that if this should occur nevertheless, no reduced railway and exposition tickets, nor recognition or courtesies of any kind would be offered or extended by the French Government. It was merely stated that a French commission had been appointed by the Government, which would take charge absolutely of the proposed congress on testing materials. The previous invitations and profuse promises of hospitable reception tendered at Stockholm were entirely ignored, in spite of the fact that the French members had voted at that time with all other members to postpone the definite adoption of statutes and election of officers to the proposed Paris congress in 1900.

It must be remembered that the World's Congress Organization Committee is composed of all of the French members of the International Association. All of these facts were submitted, and after a protracted discussion the following resolution was unanimously adopted by the American section viz.:

"That it is the sense of the American section that any invitation of the Inter-

national Association for Testing Materials tendered by the French Government should be accepted only upon compliance with the conditions stated in a resolution of the International Council, which are 'that the International Association will have localities at their disposal in which to hold a general session to discuss its own affairs.'

"This resolution shall not, however, prohibit any member from accepting any invitation offered to him personally."

This resolution will be transmitted to the council for proper consideration at future meetings, as well as the suggestion that a meeting be held in Brussels, or some other convenient city, should satisfactory arrangements fail.

When the matter of the expense of publication of proceedings and of conducting the association came up there was at once a hearty response from members and representatives of the great steel works companies, the latter saying that their companies were ready and willing to be assessed for their share, and that the amounts assessed would be promptly paid; this by way of a substantial recognition of the fact that the various steel concerns will benefit much from the work of the association.

The technical part of the meeting was begun by a paper by Prof. W. K. Hatt: "Comparison of Steel Plates under Flexure and Tension."

In this paper it was pointed out by many duplicate tests that the tenacity and location of proportional limit and yield point were not the same when determined from tension and transverse tests.

The fact was also pointed out that in a certain size of steel plate 12x1¾ inches, the P-limit and Y-points were unusually low, in fact only about 17,000 and 25,000 pounds per square inch, from repeated tests, while all other properties were apparently normal.

The paper called forth a protracted and heated discussion by Messrs. Christie, Webster, White, Kreuzpointner, Henning, and Profs. Talbot and Hatt.

Especially the steel works representatives questioned the accuracy of such low results, while those who are in the habit of making accurate tests, using micrometers and autographic recorders, or other reliable auxiliaries, all confirmed the figures given in the paper.

The association has before it the study and development of twenty-one problems, to which the American section has added four more. The first of the latter, "On the Present State of Knowledge of Impact Tests," is in the hands of Profs. Hatt, of Purdue, and Marburg, of University of Pennsylvania. The former presented a voluminous paper, going over the bibliography of the subject, but as it is not complete it cannot be presented at the present time.

It did, however, call forth some discussion and, more particularly, inquiries about the European practice, which has demonstrated the practicability of impact tests in a remarkable degree.

The preliminary report of the American members of the International Committee, No. 1, "On Standard Specifications of Testing Iron and Steel" was presented by Mr. William R. Webster, chairman of the American sub-committee.

He reported progress, and promised to report at the next annual meeting, which it was proposed to hold in May of next year.

Mr. Max J. Wickhorst, engineer of tests of the C., B. & Q. R. R., made a preliminary report on problem No. 5, "Collection of Data for Establishing Standard Rules for Piece Tests, with Special Reference to Axles, Tires, Springs, Pipes, etc." He reported that the manufacturers and railway managers had courteously answered his inquiries, but that there had been no time to digest the information obtained.

None of the other committees were prepared to report.

The American section was received with great hospitality by many of the largest manufacturers in the Pittsburgh district, and two afternoons were devoted to visiting many places of interest, such as the Carnegie Works, Carbon Steel Company, Cement Works, Westinghouse Manufacuring Company and many others.

Technical Publication.

The latest notable addition to the list of technical journals is called "Feilden's Magazine." It is published in London, and has set for itself the task of stopping the influx of American and other foreign machine tools, bridges, locomotives, etc., into British territory. This will probably prove a herculean task, and its accomplishment of very doubtful advantage to Great Britain; but, nevertheless, the task is valiantly undertaken in a manner which is described in the watchword of our new contemporary, "Militantly British." It alludes to the building of an American bridge "over a river that has been dyed with British blood," the buying of American locomotives for English railways, etc., as "a nasty fact," and in a clarion voice calls upon Britishers to awake from their slumber before it is everlastingly too late. The editor declares that "We of this journal have not set out to be alarmists; we decline to be funked, but we also refuse to shut our eyes to the militant danger with which our industrial supremacy is most unmistakably threatened. Our American cousins have taken time by the forelock. . . . Gradually, insidiously at first, aggressively to-day, they have been adopting every means of cheapening cost of production," etc., and a large part of the failure of Britishers to keep up with us is declared to be due to the lack of first-class technical journals such as are to be found here. This lack it is declared shall no longer exist. He has "set out with 'Feilden's Magazine' to remove this reproach. It will be absolutely *militantly* British in tone, character and purpose."

We have had the impression that there were some pretty good technical journals published in England, and certainly one of them has been "militantly British" enough for all practical purposes, and we do not believe that a single point is to be gained by any such tone. So far as printing, illustrations and mechanical "get up" are concerned, the new magazine is very creditable, and the first number contains a variety of interesting articles on a variety of engineering subjects. It is published by the Feilden Magazine Company, Temple Chambers, Embankment, London, E. C.

French Market for American Iron and Machinery.

The following facts, taken from a recent consular report, may be of interest:

"There have recently been many inquiries for the names of the leading firms in the United States that manufacture various kinds of machinery. A number of sales of American machinery have been made during the past year. Heretofore, considerable machinery used by the shipbuilders of Nantes has been purchased in England. English manufacturers have two advantages over those of the United States—first, their nearness to this market; second, the advantages accruing from the minimum tariff rate. For machine tools weighing over 1,000 kilograms (2,204 pounds) the maximum duty is 15 francs ($2.89), the minimum 10 francs ($1.93) per 100 kilograms (220.46 pounds); weighing from 250 to 1,000 kilograms (550 to 2,204 pounds), maximum 20 francs ($3.86), minimum 16 francs ($3.08); small tools, weighing less than 250 kilograms, maximum 70 francs ($13.50) and the minimum 50 francs ($9.65) per 100 kilograms. The difference on structural iron or that used for shipbuilding is not so great, the maximum being 6 francs ($1.15) and the minimum 5 francs (96 cents). The recent augmentation in prices and the scarcity of a visible supply of structural iron in this part of France make this an opportune time for the American manufacturer to invade this market. The nearness of the English manufacturer has given him an easy victory in the past, but the shipbuilders of the Loire have come to the conclusion that if the American iron manufacturers can sell iron in England and in English colonies, it is at least worth while to get our prices.

"I believe if the American manufacturer were on the ground with prices and terms he could capture some orders. There are three shipyards at Nantes, where there were constructed last year forty-two iron vessels, varying in tonnage from 3,000

downward. At St. Nazaire, thirty miles west of Nantes, there are extensive shipyards, where some of the largest vessels in the service of the Compagnie Générale Transatlantique were built. About two weeks since, a large war vessel for the Government of Japan was launched at St. Nazaire."

Death of Professor Bunsen.

The death of Professor Bunsen closes the earthly career of one of the great physicists of the century. He is classed as a chemist, which he was pre-eminently, but he was distinctly a larger man than that. In so far as chemistry was his specialty, he was so omnivorous a specialist that the lines of his knowledge and research radiated from it to the remotest corners of the physical field.

Robert Wilhelm Eberhard von Bunsen, born at Gottingen in 1811, was from the first surrounded by the most helpful and stimulating atmosphere for his life's work. None of his years were wasted in finding the place which he was to fill. His father had a literary professorship. The son graduated from the university when nineteen years old, and was then successively a year each in Paris, Berlin and Vienna, becoming a professor in the Polytechnic School at Cassel at twenty-two. He lost an eye by a chemical explosion early in his career. His first years of independent work led to brilliant discoveries concerning arsenic which were the key opening long chapters of modern chemistry. In 1838 Bunsen was "extraordinary professor" at the University of Marburg, and here he took up the study of the high furnace, inventing the appliances of the hot blast, and developing his method of gas analysis. He now began to find his profession lucrative, and indulged his passion for travel. In 1844 he was investigating volcanic phenomena in Italy, and in 1847 he made his celebrated voyage to Iceland. During these years he began his studies of electrolysis and the electric arc, and invented the Bunsen battery-cell, which held its own until the advent of the dynamo. In determining the specific heats of various elements he was led to invent a calorimeter far in advance of any known, and other instruments for the investigation of heat phenomena. His discoveries and inventions were continually smoothing the way for all other chemists. The laboratories of to-day are full of his contrivances, and every shop knows the Bunsen burner, while it is also an indispensable part of the Welsbach gas burner. In 1852 Bunsen reached the hight of German professional aspirations by becoming a professor at the University of Heidelberg, where he staid to the end of his days. He was faithful and enthusiastic in his routine duties as a professor, and the work by which the scientific world knows him so well was mostly "overtime" work. In the late fifties he returned to spectrum analysis, Prof. Kirchhoff being intimately associated with him. In 1883 Bunsen was elected one of the eight foreign associates of the French Academy of Sciences, which is considered the highest official honor attainable in the scientific world. The eccentricity of Bunsen's genius was in the fact that he was without any abnormal mental traits. He betrayed no stupendous egotism. He gave to all others more than their full share of credit, many times going out of his way to attribute to others what was distinctly his own. In the history of science Bunsen is likely to find a lesser place than belongs to him, from the fact that he leaves so little written record. He thought too fast to think in words, and his lectures were full of inaccuracies of language. It is said that he could not answer verbal questions, either oral or written, and could not have passed a decent examination upon his own discoveries. These discoveries are lastingly embodied in the daily practice of the laboratory and the workshop, and his life has been a mighty force in the advancement of civilization.

Questions and Answers.

Name and address of writer must accompany every question. Questions must pertain to our specialties and be of general interest. We cannot undertake to answer by mail.

(77) C. M., Schenectady, N. Y., asks: What is the difference between the United States standard pipe thread and the English pipe thread, and the Whitworth screw thread for gas, steam and water piping, as to shape and angle of thread; also, is the taper alike in all above cases? A.—The pitch of the thread of wrought-iron pipes in the United States is as follows: ⅛ inch, 27; ¼ and ⅜ inch, 18; ½ and ¾ inch, 14; 1 to 2 inches, 11½; all above 2 inches, 8. The pitch of the Whitworth pipe threads is: ⅛ inch, 28; ¼ and ⅜ inch, 19; ½ and ¾ inch, 14; 1 to 2 inches, 11; all above 2 inches, 8. The angle of the Whitworth thread is 55 degrees, with one-sixth of the top and of the bottom rounded. The angle of the United States standard thread is 60 degrees, with a flat at the top and the bottom of the thread equal to one-eighth of the pitch. The taper of United States pipe taps is ¾ inch to the foot; the taper of the male thread, as cut by the dies, is usually less than this. English pipe threads are not tapered.

Mr. George Boner, of Legnano, Italy, writes us that the item published in our issue of July 6 regarding the establishment of Franco Tosi was incorrect, so far as a contemplated reorganization into a joint stock company is concerned. The establishment is going on as usual, as a private concern, since the death of Mr. Tosi, with Mr. Boner as general manager. The enlargement of the shops is, Mr. Boner writes us, only the result of increasing demand for the engines and boilers built by the concern. Mr. Boner sends us a fine album of views of the shops and their products, which show that the concern has a very well equipped and well arranged plant and builds engines of the most modern and approved type, apparently.

Mr. B. R. Wicks, of 291 Prospect street, Bridgeport, Conn., has designed a center crank steam engine of one-quarter horsepower, and informs us that he will supply blueprints of it for those who may wish to construct such an engine.

Personal.

John A. Hill, of the American Machinist Press, accompanied by Mrs. Hill, sailed for Liverpool by the "Umbria" Saturday, the 19th, and will be away about two months.

Mr. Julius Herlitschka, manager of the Vienna branch of White, Child & Beney, importers of American machinery and tools, will sail on the 27th inst. for America, where he expects to stay about two months, visiting friends and establishing new business connections. Mr. Herlitschka will also attend the Philadelphia Export Congress as a delegate of the Vienna Chamber of Commerce.

W. F. Dixon, formerly of Paterson, N. J., and now manager of the locomotive works of the Sormovo Company at Nijni-Novgorod, Russia, sailed for Liverpool on the 16th, after having spent about two weeks here. He was accompanied by his Russian wife, acquired since his sojourn in the land of the Tzar. Upon the completion of the one hundredth locomotive turned out from the works Mr. Dixon was given a vacation and all his traveling expenses paid to visit England and America. Unfortunately, however, Mrs. Dixon was ill during her entire stay in this country, so that the pleasure of the visit was much marred.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Gear Wheels, gear cutting. Grant; see p. 16.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Forming lathes. Mer. Mach. T. Co., Meriden, Ct.

Punches & dies. Wal. M. Wks., Waltham, Mass.

Spiral gears of varying angles and ratios. The Arthur Co. See page 42.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Book "Dies and Diemaking," $1, post paid. J. L. Lucas, Bridgeport, Ct. Send for index sheet.

Agents wanted; $500 given in prizes to hustlers; booklet free. A. Byer Tool Co., Chambersburg, Pa.

Selden Packing for Stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., New York.

For Sale—Eight volumes "American Machinist," 1891 to 1898, unbound. N. H. Brown, West Derry, N. H.

For Sale—To right party, half interest in established foundry and machine shop doing good business, in good location. Box 219, AMERICAN MACHINIST.

Bound volumes of "American Machinist" for 1893 and 1894, cloth, good condition, $3 each; one of 1888, morocco, $4. "Volumes," care AMERICAN MACHINIST.

Gear and milling cutters, adjustable reamers and special tools; vertical millers, cutter and surface grinder and shears. Catalog of small tools free. R. M. Clough, Tolland, Conn.

To take the place of T-square, we make fittings which you can apply to your drawing-board; great thing for large boards; send for circular. Leighton & Wisner, Watertown, Mass.

Because of rush of work in principal lines, we will sell a minor department; any mechanic with $1,800 can establish himself in the finest business opening ever offered; close investigation solicited. L. B. Baker Mfg. Co., Racine, Wis.

Institutions retiring from business having machine tools, brass and wood working machinery will find it to their interest to correspond with us. We purchase complete plants or handle them on com. C. C. Wormer Mach. Co., 55-59 Woodbridge st., W., Detroit, Mich.

A large factory close to Boston, equipped with best makes of machinery, drop hammers, lathes, planers, polishing, plating, enamelling depts., hardening and annealing furnaces, suitable to the manufacture of automobiles, would like to figure on whole or parts of motor vehicles. Address "Confidence," AMERICAN MACHINIST.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be inclosed to unknown correspondents.

Situations Wanted.

First-class toolmaker, Eastern man, wants position; 13 years' experience; accustomed to fine work. Box 223, AMERICAN MACHINIST.

Foundry foreman wants position; heavy work, or light; experienced handling men, mixing irons; first-class references. Box 205, AMERICAN MACHINIST.

The manager of a successful foundry and machine shop has satisfactory reasons for wishing a change in location. Address "Treasurer," care AMERICAN MACHINIST.

Situation wanted by man of experience, selling machinery, tools or supplies; 9 years with present house, and can command some trade. Address "Caro," AMER. MACHINIST.

Mechanical superintendent wishes a change; thoroughly up to date in shop practice and management, with inventive ability, and a hustler. Address C., P. O. Box 1533, New York City.

Experienced mechanical engineer, graduate, wishes situation as superintendent; specialty, design and development of light, intricate mechanisms and methods of duplication. Box 211, AMERICAN MACHINIST.

Wanted—Position as superintendent, by a practical machinist of independent judgment, good executive ability, thoroughly up to date in methods, and a cost reducer; American; age 35. Box 213, AMERICAN MACHINIST.

Position as superintendent, assistant or master mechanic in manufacturing concern; thorough experience in plant construction and operation; technical graduate; would invest some money. Box 222, AMER. MACHINIST.

A first-class draftsman, who is a pattern-maker by trade, desires a change about September 1; experienced on general machines, punch and shears, machine tools and automobiles; best of references. Box 209, A. MACH.

Position Wanted—As factory superintendent or master mechanic, having held similar position for past 6¼ years; good mechanic; understands piece-work system thoroughly; best of references. Apply Box 217, A. MACH.

Wanted—Position as mechanical engineer or as chief draftsman; experienced on designing the heaviest class of machinery, plans for steam power plants and heavy mill work; has held last position for 7 years. Box 193, AMERICAN MACHINIST.

Superintendent or master mechanic, by mechanical engineer; 20 years in shop management of large plants East; practical cost-cutter; thorough organizer; hustler; wide experience in manufacturing; highest commendations; Middle or Western States preferred. Address K. T., Box 212, AM. MACH.

Position wanted as superintendent in machine shop or drop forging; have had 25 years' practical experience in laying out work for both branches, also understand all about case-hardening, also the tempering of various kinds of dies, and good manager of help and producing work at reasonable prices, and do the estimating, which is an important part; age 45. Address Box 218, AMER. MACHINIST.

Help Wanted.

Wanted—Draftsmen; competent men used to blast-furnace work preferred; give references and experience. Box 215, AM. MACH.

Wanted—A shrewd, intelligent and thoroughly honest man, to act as an inspector; must furnish good references. Address Box 216, AMERICAN MACHINIST.

Machine tool designer, thorough draftsman; excellent opportunity; salary according to ability; give age, experience and references. Address P. O. Box 88, Cincinnati, O.

Machinists Wanted—One lathe man, several floor men; light machinery; country town 25 miles from New York; steady work for good men. Address Box 224, AM. MACH.

Wanted—Chief draftsman; must be quick, accurate, familiar with modern methods, able to organize drafting department; state experience, reference and salary. Box 198, AMERICAN MACHINIST.

Wanted—Good machinists who have had experience on accurate work; none but good, all-around workmen will satisfy us; give age, wages wanted and references. Leland & Faulconer Mfg. Co., Detroit, Mich.

Wanted—Foreman for machine shop in a large bicycle company; a good opening for the right man; applicants will state their experience, reference, age, salary, etc. Address Room 423, Ashland Blk., Chicago, Ill.

Wanted—Thoroughly competent man to take charge of machine shop for the finishing and assembling of marine engines; write, giving age, experience and salary expected; confidential. Address Lock Box No. 1042, Philadelphia, Pa.

Wanted—Superintendent, experienced in first-class shop practice, to cut costs and organize and systematize growing shop; good place for a good man; state experience, methods, references and salary. Box 197, AMERICAN MACHINIST.

Wanted—First-class man, not over 45 years of age, as superintendent of an old-established manufacturing concern, located about 50 miles from New York City, employing 500 people, engaged in brass goods manufacturing; must understand modern factory methods. Apply by letter to Box 214, AMERICAN MACHINIST.

Wanted—A thoroughly informed toolmaker, not only up on small tools, but understands handling lathes, planers, etc., and knows their maximum capacity; must be familiar with modern methods and have practical ideas; to take position as assistant foreman when sufficiently acquainted with work. Box 225, AMERICAN MACHINIST.

Wanted—Experienced lathe, planer and vise men, also several men and boys who have done more or less machine work, by a high-grade machine tool company located near Milwaukee; shop is new, fitted with all modern conveniences, and is strictly up to date in every particular; steady work and opportunities for advancement to the right parties; write, stating wages expected, experience, age, etc. Box 221, AMERICAN MACHINIST.

Mechanical Engineer—Corporation recently organized controlling patents on a new furnace already in practical operation require services of mechanical engineer especially skilled in boilers and furnaces; one competent take charge, make plans and specifications of work and supervise installing same; a shop experience would be considered an advantage; give particulars of experience; communications confidential. "Skilled," Box 220, AMERICAN MACHINIST.

Wanted—A technical college graduate of at least 3 years' practical and responsible experience in the designing of special machinery; application must contain a list of at least a dozen machines (not engines) designed by candidate, and also contain an outline of the variety of work he would give to each of a score of seniors on the basis of 300 hours, and propose a method of conducting this work; please state frankly minimum salary that would be accepted; promising candidates will receive additional information from a circular that will be forwarded; required work begins September 25. Send promptly list, outline and references to Professor of Mechanical Engineering, 357 Market st., Bethlehem, Pa.

All bids for the construction of the new shops at the Brooklyn Navy Yard have been rejected. The lowest bid, that of Post & McCord, was $519,306, while the limit of the appropriation is $325,000. It is said that new specifications will be made and new bids called for. The changing of the specifications in the direction indicated is much to be regretted, as the imperative need of a modern and sufficient plant is certainly not more than met by the specifications as they are. The correct thing in this case would seem to be to increase the appropriation. A single battleship complete costs four or five millions of dollars, and the chief construction and repair shop for the navy might properly cost as much.

At the Cramp shipyards last week 1,500 men were laid off on account of the lack of material, while if all material could be promptly secured the company would, instead, be able to give employment to 1,500 additional men. The men affected are those working on hulls and frames, who earn from $14 to $24 per week. The Cramp Company's existing contracts aggregate about $20,000,000. The men still employed number 3,500.

Manufacturers.

It is reported that Spring City, Pa., is to have a new iron foundry.

The Grant Machine Tool Works, Cleveland, Ohio, contemplates the extension of its plant.

Samuel Donachy, of Hanover, Pa., is interested in the establishment of a new match factory at Bellefonte, Pa.

The indications are that the Sylvan Steel Works, Moline, Ill., will start soon, and that the company will agree to the amalgamated scale.

A building permit was issued recently to A. Bloom & Co., Omaha, Neb., for the erection of a planing mill, 30x60 feet, and two stories in hight.

The Structural Iron Company, Baltimore, Md., will erect a $10,000 foundry of iron and brick at Bush and Ridgely streets. Work will begin at once.

The White Manufacturing Company, Philadelphia, Pa., is to have an addition made to the plant. This addition will be 34x28 feet and two stories high.

Bids were opened recently at Schenectady, N. Y., for the enlargement of building 83 of the General Electric Company. The plans call for an addition 140x240 feet in dimensions.

An addition is to be made to the plant of the Lorraine Manufacturing Company, Pawtucket, R. I. This addition will be 86x95 feet, for which new machinery will be required.

The Spencer Wire Company's new plant is to be erected on Webster street, New Worcester, Mass. The building will be 200x50 feet, and there will be two stories and a basement.

The National Electric Company, of Philadelphia, Pa., intends making alterations and additions to its plant at Twenty-sixth and Carpenter streets, and has prepared plans for the same.

The Louis Newburg Tobacco Company have just awarded a contract for a factory building in East Hamilton, Ohio. The new struc-

ture will be of brick, with a flat roof, and 218 by 211 feet in dimensions.

David Carlin, of Allegheny, is organizing a company, to be capitalized at $200,000, to build a plant to make soil pipe. The plant will be erected in the vicinity of Pittsburgh.

The Edgar Heafer Tile Company, Bloomington, Ill., has been incorporated with $25,000 capital. The purpose is to manufacture brick, drain tile and clay products, and the incorporators are Edgar Heafer, Arthur Heafer and J. B. Holmes.

Milton, Del., has determined to have an electric light plant. A franchise has been granted to James P. Morrison, Charles P. Taylor, Frederick H. Russell and Charles W. Cullen. Work on the plant will be commenced within six months.

The Enterprise Manufacturing Company, of Third and Dauphin streets, Philadelphia, Pa., will make alterations and additions to the property at above address, and estimates for the same will be taken immediately. A new granite front and brick addition will be constructed at a cost of $5,000.

A mill is to be erected at Hazleton, Pa., for the Hazleton Plush, Velvet & Silk Mill Manufacturing Company. A brick and iron framed building, with slag roofing, cement and pine flooring, plumbing, electrical fixtures, etc., will be constructed on the latest principles of slow-burning construction.

The Morris County Folding Box Company, which was recently incorporated at Trenton, N. J., for $50,000, with William J. McGee, of this place, as president, has purchased a piece of property on the Whippany River at Whippany and will soon begin the erection of a factory, which will employ over 100 hands.

A movement is on foot to have the Struthers Iron & Steel Company rebuild its sheet mill at Niles, O. The company announced, through its president, John Warner, recently, that the mill, which was burned to the ground, would be replaced just as soon as the insurance adjusters get through with their work.

There is promise that Minneapolis capitalists, among them W. D. Douglass, G. F. Piper and R. F. Brett, will soon build a big linseed oil mill, the cost to be in the neighborhood of $225,000. The plant will be located at Midway, Pa. The mill will consume from 2,500,000 bushels to 3,000,000 bushels of flax tax annually.

The Sterling Boiler Company are making the following additions to their plant at Barberton, O., namely, 60x100 feet to the foundry; a machine and erecting shop, 60x182 feet, for the marine boiler department; a plate and stock shed, 60x160 feet; an extension to the boiler shop, 80x80 feet; a tube-bending shop, 30x50 feet.

The rapid increase of its business during the past few months has resulted in the Pencoyd Iron Works Company purchasing a large strip of land on the Philadelphia side of the Schuylkill, at Wissahickon, for the extension of its plant. The new addition is a quarter mile long and varies in width from 50 to 300 feet. Nut, bolt, eye-bar and axle shops will be begun as soon as possible.

The Pennsylvania Malleable Iron Works have been granted the right of way by the McKees Rocks (Pa.) Council for the construction of a branch railroad and the necessary switches to connect their proposed new works with the Pittsburgh & Lake Erie Railroad and the Pittsburgh, Chartiers & Youghiogheny Railroad at that place. In the requests for these privileges the company proposed to construct a plant for $100,000 and employ 1,000 men. The main building is to be 640 feet in length and 220 feet in width, containing a foundry, annealing rooms and power house.

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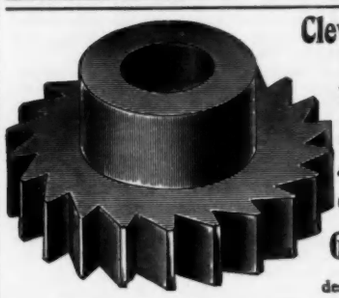

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You'd better write to us about it anyhow.
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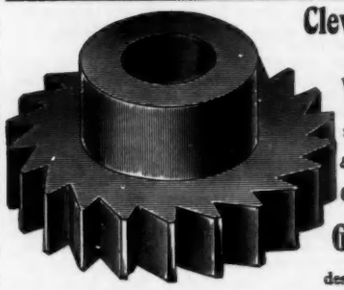

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